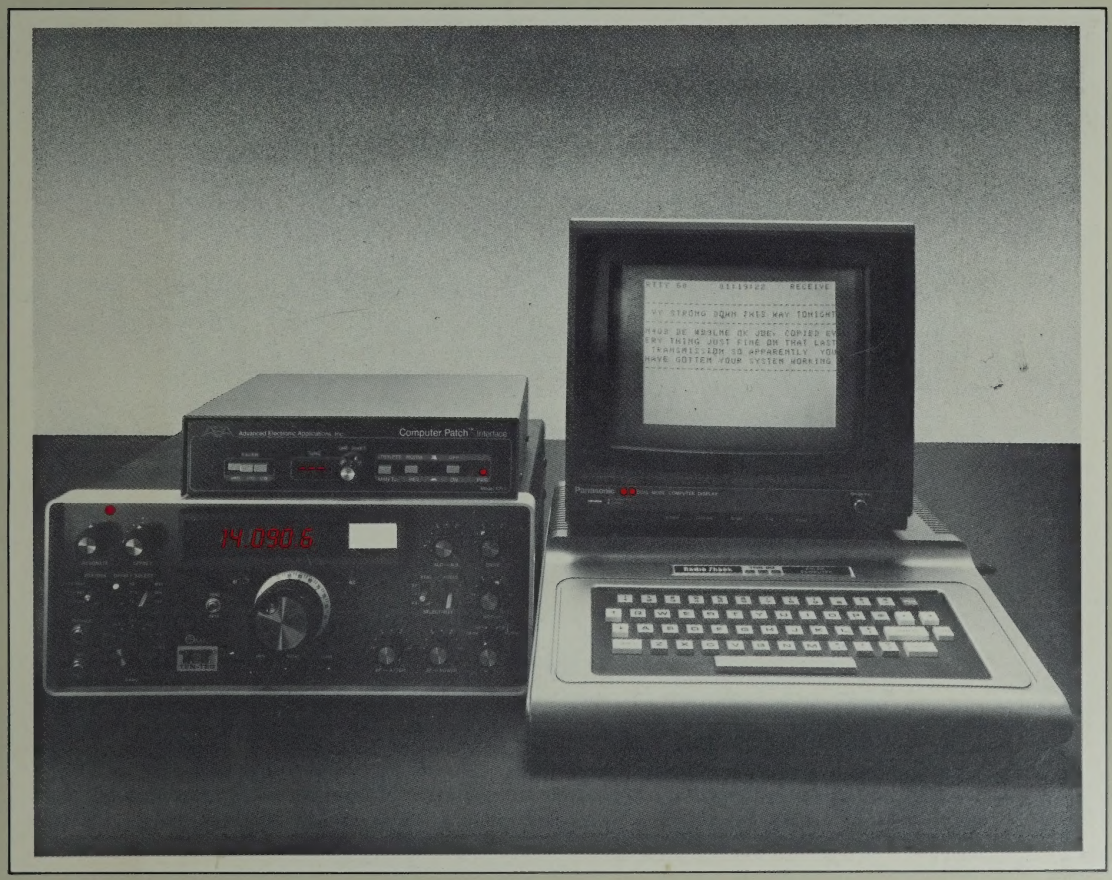
RTTY TODAY

MODERN GUIDE TO AMATEUR RADIOTELETYPE

- ☐ ANSWERS ALL AMATEUR RTTY QUESTIONS
- ☐ FULL COMPUTER RTTY QUESTIONS
- ☐ COVERS ALL NEW TELETYPE EQUIPMENT



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RTTY Today

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MODERN GUIDE TO AMATEUR RADIOTELETYPE

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Shortwave publications and frequency lists.

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by Dave Ingram, K4TWJ

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Preface

The world of Radioteletype has traditionally been recognized as one of amateur radio's most popular areas of specialized communications. This situation is particularly true today because of two independent reasons: RTTY gear has progressed into the electronic rather than mechanical category, and because a vast number of radio amateurs have become interested in printed word communications.

In addition to the large number of recently introduced RTTY interfacing systems for home computers, a full array of dedicated RTTY terminals are also available to today's innovative minded amateur and/or shortwave listener. The beauty of these systems are ease of setup, adjustment and use. This promising new era is thus opening new horizons for semi-technically orientated individuals desiring to join the action in a straightforward manner.

Realizing that several books have been written on the technical side of specialized communications and RTTY, this book thus focuses on more basic and factual areas of what's available, exactly what it is, how it interconnects, and how they are used. This layman's guide to modern RTTY could easily be categorized as "must reading" for any amateur interested in joining the activity of amateur teleprinting.

Several innovative concepts have recently affected RTTY: AMTOR and ASCII are two examples. Discussions of these teleprinting concepts are included in several chapters for your knowledge and use. As you will also notice, this book is written in an "amateur to amateur" manner . . . hopefully conveying the same friendliness and understanding of a personal visit with the author as your host and guide to an exciting new area.

RTTY SWLing is also an extremely popular area which is becoming more widespread each day. This is surely due to quests for accurate and timely information direct "from the source". Bearing those thoughts in mind, chapter eight contains a special treat: a collection of information and listings on today's "hot spots" of RTTY broadcasts . . . an accurate frequency guide which you can use immediately for receiving some of the most exciting transmissions on shortwaves. These "pick of the crop" listings could, in themselves, prove worthy of this book's cost.

If you're considering joining the action of RTTY today . . . if you're an active TTY'er . . . if you're wondering what's "out there" for investigation, we urge you to add this book to your library or reading list. It's an all-inclusive RTTY volume you'll find useful for many years.

Preparing a book of this nature was an extensive undertaking requiring efforts and information from numerous individuals and companies. I would like to express sincere thanks to the following: Phil Anderson and the Kantronics group, Mike Lamb and Advanced Electronics Applications, Martin F. Jue and MFJ Enterprises, Microlog, Macrotronics, Fred Sharp, W8ASF and "Blinky Company", HAL Communications, DGM Electronics, InfoTech Company, and cover photo by Joe Ferris N4QB.

Dave Ingram K4TWJ

CHAPTER 1

THE EXCITING WORLD OF RTTY

The printed communications mode of Radioteletype, or RTTY, boasts a history dating to the early days of wireless, yet this same mode reflects some of the latest innovations and trends in amateur radio today. Each day, expanded RTTY activity can be noted on both international shortwave and amateur bands. This may be considered only a tip of the coming iceberg, for tomorrow's data communications and home computer interlinks are being pioneered and "entrance level" instigated at the present time. The 1980's are, indeed, destined to be an exciting era in both spoken and printed word radio communications, and this book is your personal guide to that era!

Escalated by the introduction of inexpensive microprocessor and home computer and RTTY interface systems, this unique mode has become a worldwide craze with a very promising future. Hand keys and desk mikes are now sharing space with computer-type keyboards while two-toned messages fill the airwaves in rising numbers. This "new generation" of microprocessor-based RTTY offers many capabilities unobtainable with older systems; indeed, one needn't be a grandmaster of the "green keys" to join the fun. Although a reasonably swift typing ability is helpful, it is no longer a prerequisite for RTTY operations. Preprogrammed, or "canned messages" can be stored for immediate recall while type ahead buffers allow preparing outgoing messages during periods of reception. The end results are a stream of transmitted information which gives the impression of a true "hot shot" RTTY operator . . . until stored information runs dry and one must take to the keyboard in real time. All aspects considered, however, the new generation of RTTY is a fascinating area holding unlimited appeal to modern radio amateurs. **(See Figure 1-1).**

The popular home computer-type RTTY systems are quite different from their mechanical counterparts of yesteryear. Whirring motors, contact-keying cams and pawls, rods, levers, etc. have given way to silent keyboards, large printed circuit boards with numerous Integrated Circuits and small cathode ray tube video displays. As an extra bonus, the home computer itself may be removed from amateur use and quickly reprogrammed for a wide variety of operations ranging from home finance and inventory calculations to an unlimited number of arcade-type video games. Sound interesting? Read on, as this book is dedicated to the "new RTTY" which you can enjoy with miniscule effort. Our "heavy technical descriptions" have been sidestepped with plain language discussions; ultimately resulting in the straightest way to enjoyment of this exciting (and interest-renewed) mode. **(See Figure, 1-2, 1-3.)**

RTTY REFLECTIONS

During past times RTTY was classified as one of the more popular forms of "specialized" amateur communications. That situation was related to appeal among mechanically-inclined individuals who enjoyed tinkering with the teletype machines of previous decades, and the comparatively low cost of those pleasantly chattering units. Many of today's RTTY operators still enjoy using those mechanical marvels on the air and a creditable number of large Western Union and Bell Telephone teleprinters continue purring like a kitten in amateur setups around the world. These units add a special "warmth" to one's radio room: the gentle tapping often being audible in adjacent rooms while off-the-air messages are printed on the ever popular rolls of yellow tinted paper. An amateur leaving his operation briefly often gets the impression of a "mechanical robot" overviewing conversations in his absence, and yet retaining that information for his review when he returns. There is, indeed, a special nostalgic pleasure in using older mechanical teleprinters which must be experienced to be appreciated.
(See Figures 1-4 and 1-5).

Properly initiated, older model mechanical teleprinters offer the least expensive way to become operational on RTTY. Assuming a relatively clean unit in good working condition can be hamfest-purchased inexpensively, the TTY'ers plight is half complete. Wiring can be traced to cam-actuating magnets, and their operating current can be determined with the aid of an adjustable and metered DC power supply. A basic but effective RTTY demodulator can then be home constructed and its output connected in series with the previously mentioned DC power

Figure 1-1 *A classic example of "going first class," the dedicated RTTY/ASCII/CW Terminal by HAL and transceiver by Collins depict the ultimate setup for RTTY today. Desk by S-F Radio.*

supply (called a loop supply) for decoding and printing of off-the-air signals. As the frequencies associated with RTTY demodulators are within audio and DC ranges, few layout and construction problems are usually experienced. Indeed, the author has constructed several RTTY demodulators on simple perfboard (some being "bare bones units," and some being multistage units), and each always performed quite acceptably.

If you own one of the "deluxe" or "full featured" amateur transceivers, transmitting RTTY signals may be an easy matter. Assuming the transmitter features an internal Frequency Shift Keying circuit and a rear panel connection is provided, one merely needs to add a keying relay to activate that terminal with Baudot pulses. The keying relay is placed in series with the teleprinters loop supply, and the demodulator's "keying output" is shorted to allow continuous motor drive. As the teleprinter's keyboard is then activated, the relay keys the transmitter's internal RTTY oscillator. If the employed transceiver doesn't include an RTTY circuit, the amateur must once

Figure 1-2 *Opening new doors in amateur radio enjoyment, home computer systems and mating RTTY interfacing systems are todays most popular accessory items. Units shown here are produced by Kantronics, MFJ Enterprises, and Advanced Electronic Applications. Supporting software packages are available for a host of home computers.*

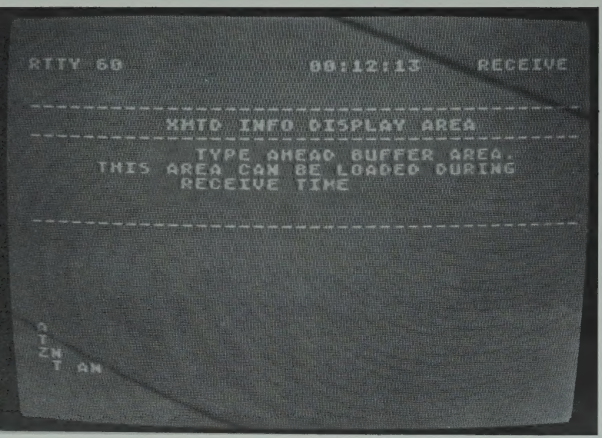


Figure 1-3 *Close-up view of home computer/RTTY interface system's monitor screen. Note display of operating parameters at top, middle transmit section and type-ahead buffer. Bottom screen area displays received information.*

RTTY TODAY

The introduction of microprocessor controlled all electronic terminals and amateur radio interface systems for home or "personal" computers has recently produced a true revolution in RTTY operations and activities. Boasting numerous special features and simplicity of both interconnection and use, these setups can be assembled from a host of readily available commercial items and connected for use with an amateur SSB transceiver within a couple of hours time. Such RTTY systems truly reflect the trend of future innovations and evolutions: a convenience and enjoyment orientated mode which can be tailored to one's particular lifestyle.

Unlike many first impressions, a knowledge of computer technology or computer programming isn't necessary for using modern RTTY setups. Commercially manufactured hardware (the electronics interfacing the home computer and the amateur transceiver) and software (the medium which programs the computer for amateur RTTY and/or ASCII operations) handle all of the computer's "transformations" or "face changes." Following those brief interconnections and program loading, the system "looks" identical to a direct-purchased RTTY system.

again take to homebrewing and construct a simple but effective Audio Frequency Shift Keying oscillator. Simply described, that unit would accept relay keying pulses and use them to change audio tones of an oscillator which would then connect to the SSB transmitter's mike input. The on-the-air transmitted result would be a frequency-shifting tone identical to other RTTY signals.

Does the concept of possibly restoring and using an older model mechanical teleprinter unit hold merit for budding RTTY enthusiasts? Probably . . . depending, of course, on your finances, the cost of a located teleprinter and the seriousness of your interest. Mechanical parts wear, and the machine will surely require maintenance and repairs. Modern "frills" or type ahead buffers, video displays, etc., will not be available. The mechanical unit, however, may be "just the ticket" for kindling RTTY interest. Later, you might pass the large "mailbox unit" onto another RTTY-curious amateur and move up your own system to a microprocessor-based or computerized RTTY station. Planning ahead in these moves has its benefits, for one may unknowingly invest finances exceeding 300 dollars . . . a "breaking point" at which a home computer-type RTTY setup could be instigated. The nostalgic aspect, however, may override such considerations. **(See Figure 1-6, 1-7.)** Every amateur surely wants to retain some memory of our heritage — whether used daily or merely on special occasions. Right?

Figure 1-4 *A true classic from the past, this Model 14 tape printer can prove an exciting experience when occasionally used on RTTY today. Messages are printed along a narrow paper strip which loads into a cannister on the machine's right side and feeds out below the window on the left front.*

Figure 1-5 *A large number of radio amateurs were introduced to the exciting world of printed word communications via the classic Model 15KSR (Keyboard Send Receive). Unit shown here is its Receive Only equivalent, the Model 15RO . . . a true gem then . . . and now.*

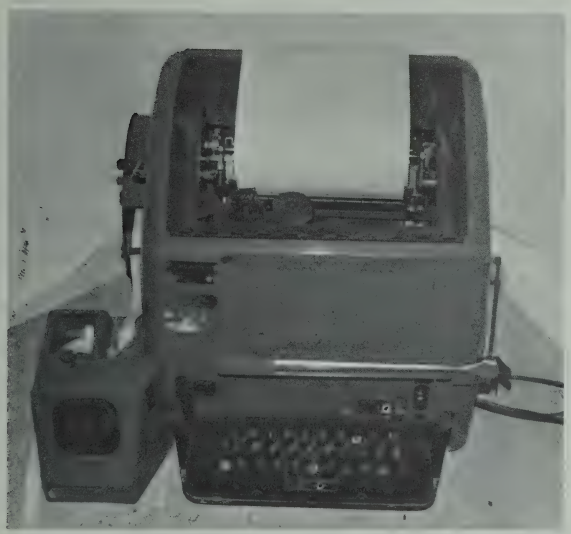


Figure 1-6 *The Model 19KSR is a complete and smooth running bundle of mechanical marvels which can be used quite successfully on RTTY today. The nostalgic appeal of this teleprinter is tremendous.*

Figure 1-7 *Compact and relatively quiet running, the Model 26 teleprinter holds appeal to many beginning RTTY enthusiasts. Add loop supply, demodulator and AFSK generator, and it's ready for amateur action.*

Exactly how difficult is that initialization, or computer transformation? **(See Figure 1-8.)** Assuming the radio amateur presently owns and operates an HF SSB setup, the following steps are usually involved in RTTY adaptation. First, a shielded cable is connected from the transceiver's speaker output to the RTTY interfacing unit's audio input. A parallel, or "normal through," connection at this point allows the speaker to continue working normally. Next, a shielded cable carrying audio output and transmitter push-to-talk keying from the interfacing unit is connected to the transmitter's mike input. This permits the computerized RTTY system to key the mike line for transmitting, and it directs Audio Frequency Shifting tones from the interface to the transmitter. Next, a 5 or 6 wire cable is connected from the interfacing unit to the computer. This cable carries binary-coded voltages and start-stop signals which were converted from incoming audio tones to the computer, and vice-versa during transmit. These voltages are usually TTL compatible (Transistor Transistor Logic), or +5 volts = binary "1" and 0 volts = binary "0." As a means of CW id for RTTY operations, a hand key or keyer is usually connected through the interface unit to the transmitter. This provides the slight tone shift for CW id, and eliminates the need to switch rig modes for end of transmission id's. Finally, the computer programming medium is mated with the computer proper for translating binary information from RTTY to a medium "common" to the computer itself (and vice-versa during transmit opera-

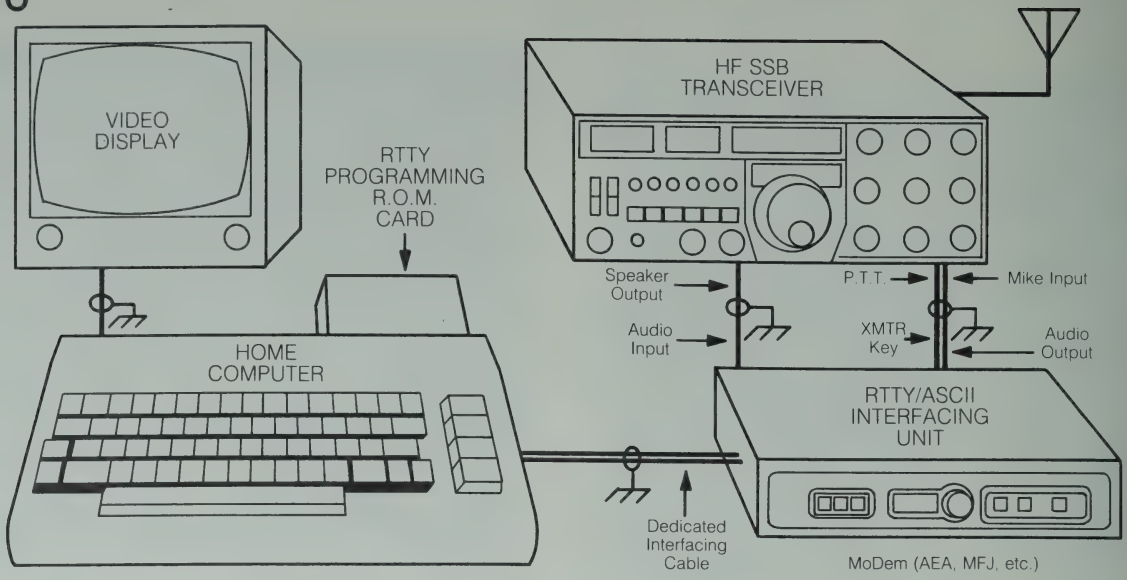


Figure 1-8 *Basic example of a home computer system interfaced for RTTY/ASCII operation with an HF Transceiver. Computer programming software may be available via cassette tape, plug-in ROM card or Floppy Disk. Interfacing unit acts as a MoDem between Computer and Transceiver.*

tions). This programming medium may be cassette tape, floppy disk or ROM chip, depending on the particular manufacturer and/or home computer utilized. The basics of this programming involves a pair of "translate tables" for the conversions of the two electronic languages. This process is outlined in **(Figure 1-9).** During receive, incoming Baudot-coded pulses are directed to a designated portion of the computer's buffer. Character-by-character, this information is moved through the programmed translate table and into a designated portion of the computer's memory (and output for visual display). A separate portion of the computer's buffer is used for holding "type ahead" and "canned message information." During transmit, this information may be recalled and directed to the outgoing translate table. Following that conversion the "ready to transmit" Baudot pulses move through memory, onto the display, and to the external Baudot pulse to RTTY tone generating interface unit. As we've pointed out, however, the amateur RTTY enthusiast needn't be informed or knowledgeable on computer intra-operations: he can merely operate the computer as an RTTY terminal and enjoy the fun. Some of the recent spin-offs of computerized RTTY include techniques of selective calling, electronic mailboxing and data packet networking. Essentially, these concepts allow the radio amateur a heretofore unknown freedom in operation. Rather than sitting at the station console for extended periods waiting for a distant amateur to become operational on frequency, the outgoing message or messages are prepared during a convenient time and left in the system's electronic mailbox for polling. Later, the distant amateur can establish communication and positive identification with the electronic mailbox and retrieve his message plus leave a reply for later review. These printed information techniques of communications hold extensive flexibility and applications for today's busy radio amateurs. Additionally, DX communications via these means can relieve the necessity of untimely operations between various time zones of the world.

The instigation of Phase III and Phase IV OSCAR satellites will open an exciting era in electronic mail — type amateur communication. Phase III satellites, the first of which was launched during mid-1983, provide full hemisphere communications for 12 or more hours each day on a reliable and predictable basis. Essentially this means distant amateurs maintaining scheduled communications via Phase III OSCARs will experience success on a continuous basis. Once initial amateur operations via these satellites settle to a calm pace, the on-board microprocessor-controlled message center can be opened for general use. A number of amateurs may then leave notes

or bulletins for the general population or for specific amateurs. Polling, reviewing and updating those messages can be carried out on an "as required" basis, sidestepping the old syndrome of being on-the-air at the right time. Phase IV OSCAR satellites will add several additional steps to the previously described concepts. Earth based data packet networks which are gaining popularity at the present time will uplink to those satellites for long range distribution of amateur messages in printed form. Thousands of amateurs can leave their receivers monitoring the RTTY-based network, but equipment will sit quietly until its particular access code is specified by the system. All of the previous concepts have been or are being pioneered at the present time. The equipment employed is usually dedicated all electronic RTTY terminal units or RTTY interfaced home computer systems. HAL Communications terminals are good examples of dedicated units while Commodore 64 or Radio Shack systems with amateur-related hardware and software are examples of home computer systems. **(See Figure 1-10).** Either arrangement can easily be interconnected on an amateur HF or VHF SSB setup.

Another recent spin-off of computerized RTTY activity has been the adoption and growth of high speed CW communications on HF bands. This "natural evolution" began with the introduction of microprocessor controlled CW keyboards and expanded when home computer RTTY systems include Morse and ASCII operations. Today, a creditable number of amateurs use their computer keyboards for generating high speed Morse and related video displays for reading incoming replies. The normally employed speeds range from 50 to 85 words per minute: a significantly fast pace which poses few problems for today's Morse readers.

In addition to transferring CW activities to printed word communications, high speed Morse operations reflect less than the 100 percent duty cycle associated with RTTY operations. This less strenuous burden allows amateur transmitters to run cooler and perform more reliably over extended periods of time. As this book is being written, specific frequencies for high speed CW operations haven't become universally adopted. We, thus, suggest monitoring CW frequencies for that obvious accelerated CW and maintaining your own frequency lists for future use and reference.

A final spin-off of modern RTTY systems has been the adoption and use of ASCII communications. Since most of the home computers are equipped to communicate in

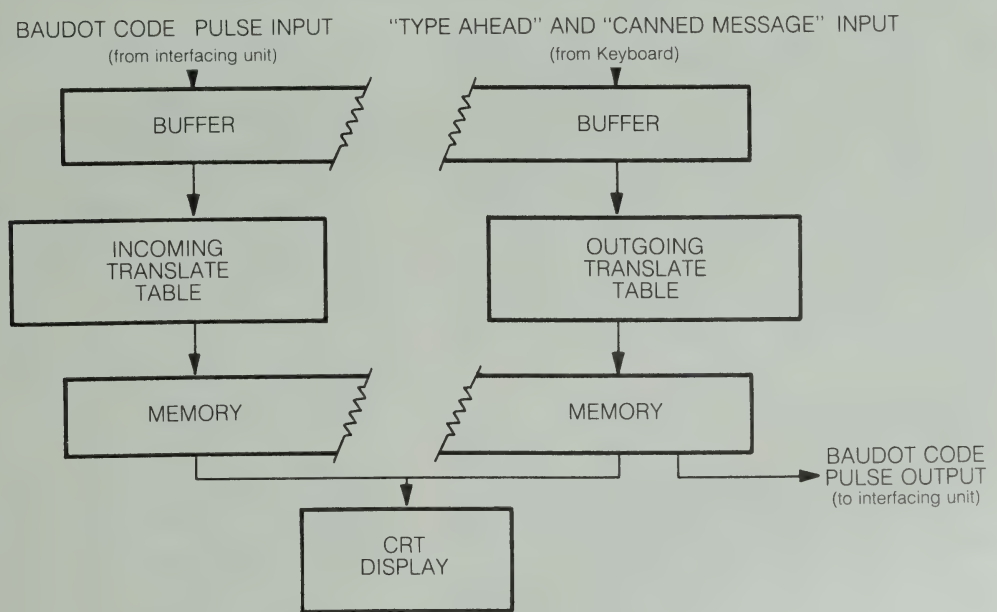


Figure 1-9 *Simplified outline illustrating how data is manipulated within a home computer or microprocessor-based system for RTTY operations. Baudot input and output consist of voltage pulses which are converted from/to Audio Frequency Shifting tones by the RTTY Modulator/ Demodulator unit proper.*

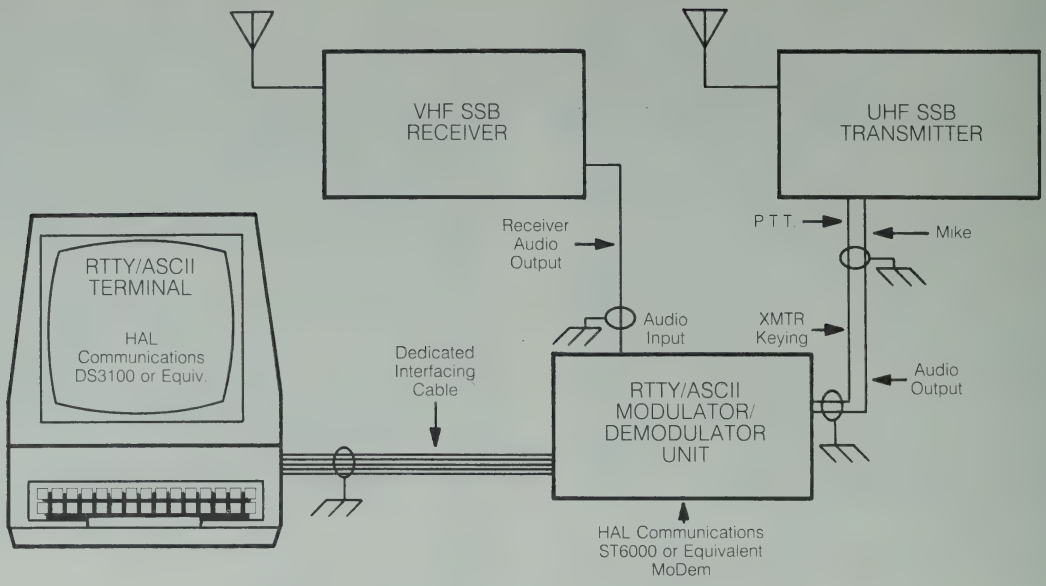


Figure 1-10 *Simplified example of a dedicated RTTY/ASCII Terminal setup. System illustrated employs separate VHF and UHF rigs for full duplex operation via long range OSCAR satellites (Phase III and Phase IV crafts).*

their "natural language" of ASCII (American Standard Code for Information Interchange), it was expected this mode would quickly rival the ever popular Baudot RTTY code in popularity. The F.C.C. thus authorized amateur use of ASCII during the early part of 1983.

As this book is being written, ASCII communications haven't yet acquired popularity. Indeed, the only station we've located using ASCII has been the A.R.R.L. station, W1AW. Bulletin transmissions from W1AW are transmitted each day, and thus serve as an ideal means of checking one's ASCII-compatible terminals.

"STAND ALONE" RTTY/ASCII CONVERTERS

Moving somewhat laterally to the present trend of computer-based RTTY systems, we find another teleprinterless concept with some very promising capabilities: independent Morse, RTTY and ASCII converters. These compact units may be visualized as a combination RTTY/ASCII reader (which uses a multi character fluorescent tube or LED readout) and a CW to RTTY or ASCII buffered message converter plus a creditable amount of control/support circuitry and RTTY filters. At least two commercial manufacturers are producing these units, and their future looks extremely promising . . . especially for the numerous radio amateurs that want to join RTTY action but simply don't care for typing messages (yes, you read right: RTTY operations without a keyboard). Advanced Electronic Applications of Lynnwood, Washington produces a unit known as MBA-RC, and Kantronics, Inc. of Lawrence, Kansas, produces a compact unit called Mini-Terminal. Both units display incoming RTTY of 60, 67, 75 or 100 wpm on their "time square" type moving display (the Kantronics unit contains a 10 character display. The AEA unit contains a 32 character display). The unique feature of these units, however, is their ability to convert Morse code (from a hand key or electronic keyer connected to that unit) to 60, 67, 75 or 100 wpm RTTY. The unit thus becomes a complete and "independent" RTTY or ASCII communications terminal which directly connects to an HF SSB transceiver. Since either of these units are powered from a 12 volt DC source, they can be used portable or mobile as desired: a quite unusual feature for RTTY setups.

AMTOR

One of the most recent innovations in printed word communications has been the authorization and use of AMTOR: a virtually error-free form of teletyping messages between two or more stations. AMTOR itself is an

acronym for Amateur Teletype Over Radio . . . a derivative of the SITOR code used extensively in ship to shore communications. The concept of AMTOR involves using a 7 bit code for each character or letter; each specifically containing 4 "on" and 3 "off" bits. This 4 to 3 ratio is continuously checked for correctness; if improper; that specific received character is rejected as "wrong." The popularly accepted speed for AMTOR communications is 100 baud (which, incidentally, translates to 132 wpm). Likewise, the popular AMTOR "mark" and "space" audio frequencies are 2125 and 2295 Hz: a conventional 170 Hz shift. In many respects, AMTOR thus bears a resemblance to regular RTTY. Some of the differences, faster speeds and bit-makeup of individual letters, however, does not allow direct compatibility between the two modes. Separate amateur systems are required for each. This doesn't present any problems for non-technical amateurs joining the AMTOR action, as several manufacturers are producing AMTOR converters which operate with one's existing microprocessor-controlled RTTY system. The AMTOR unit installs in the "speaker line" ahead of the normal RTTY interface or converter. Switching between RTTY and AMTOR is thus a relatively simple maneuver, especially if the Forward Error Correction (FEC) mode is used.

There are two popular modes of AMTOR emerging at this time: ARQ, or Automatic Request for Repeat and Forward Error Correction.

ARQ is normally employed between two specific communications stations, with back-and-forth "chirps" being the telltale clues to the operation. Fast CW-type break-in operation is required for this mode of AMTOR. FEC is the AMTOR mode used for "broadcasts" to more than one receiving station. The most commonly known example of this mode is the nightly AMTOR bulletin transmissions from W1AW (following their normal RTTY bulletins). FEC has two unique parameters "going for it:" The constant 4 to 3 bit ratio, and each character cluster is transmitted twice. At the receiving end(s), the characters are checked for correctness and the "dual characters" are used to prove a single "perfect character," (sort of like, saying each word twice on SSB, so perfect copy is achieved).

Future acceptance and success of AMTOR is relatively uncertain at the present time. On one hand, it could fall into the vague area which was experienced by ASCII. On the other hand, it could become the universal evolution of 1980's communications. Time will tell. Additional and more technical details on AMTOR are presented in a following chapter of this book.

ON THE AIR WITH RTTY

Operating or merely monitoring RTTY today is an exciting and enjoyable experience. Printed word communications, indeed, create a different "air" than SSB voices or CW tones normally filling a radio room. In fact, many RTTY operators keep in-shack sounds quite low and merely read incoming transmissions in an informative manner.

Some of the attractive diversities in RTTY are "instant QSL's" which can be directly printed on one's receiving setup and the many forms of RTTY art. A number of RTTY enthusiasts devote considerable time and effort perfecting those displays and storing their "works" for immediate transmissions upon demand.

If you're new to the RTTY game, spend some time tuning signals on the ham bands. In addition to becoming familiar with the three variables (speeds, frequency shifts and tone polarities), you'll also gain a good insight to conversation trends and techniques. Unlike CW, for example, most RTTY operators type-out words rather than abbreviating them. "Best regards" is more common than "73," "Be seeing you" preferred over BCNU, etc. The time spent monitoring RTTY activities will thus yield returns of appearing to be more of an "aged" rather than "neophyte" when you first take to the air-waves with your RTTY activities.

Acquiring the "knack" for tuning RTTY signals is, in a way, similar to tuning SSB: not difficult, but tricky to describe merely via print. Bear with us, and try to visualize the concept. If you're monitoring the amateur bands, remember the majority of RTTY communications are 170 Hz shift (narrow), normal tone polarity and 60 words per minute. If at all possible, use an accurate tuning indicator which also displays frequencies of audio tones. Knowing you've tuned an RTTY signal to produce the correct tones (2125 Hz mark; 2295 Hz space), the interfacing or terminal unit can be set accordingly. This leaves you free to "step through" RTTY speeds of 60, 67, 75 and 100 wpm until accurate copy is achieved. If at that time copy can't be acquired (and assuming 2125/2295 Hz are still showing on the tuning indicator), switch the interfacing or terminal unit to "reversed" tones and again step through teleprinter speeds. At some time in the previous procedure, you will surely achieve smooth copy: the odds are 95 percent, with the other 5 percent being due to an improper tuning indicator, an off-frequency interfacing unit or a signal too near the received noise level. The previously described techniques may also be applied when tuning news or military RTTY transmissions. Again, an accurate

frequency tuning indicator is suggested. Most of these non-amateur signals employ 425 Hz shifts. Use your tuning indicator to confirm or deny that fact, then set your terminal/interfacing unit accordingly. Again "step through" teleprinter speeds and, if necessary, switch to "reversed" tones to achieve copy. As we said, this tuning technique is easier accomplished than described. Try our "1, 2, 3 technique" for yourself and see! Some RTTY TU's have automatic speed read out feature, INFO-TECH M 200, M 600.

SUMMARY

The previous information was presented as a non-technical overview of RTTY today. Hopefully, we've enlightened you on the many possibilities and unique capabilites of printed word communications. If, through some unexplainable action, your interest in amateur radio has waned during previous times, we urge you to consider the refreshing attitude provided by RTTY. It's great fun and enjoyment which might best be described as experiencing a complete new world of amateur radio communications. Don't simply take our word for this, however. Try it for yourself and see!

Having covered the preliminaries and "glamour side" of Radioteletype, we're now ready to move into more specific areas of discussion. The following chapters are arranged accordingly to permit your expansion of interest and to answer those popular questions of what various units do and how they are used. Read all of each "equipment" chapter closely; there are new viewpoints and detailed explanations added every few pages.

CHAPTER 2

OPERATING PARAMETERS AND CONCEPTS OF RTTY

While RTTY is usually considered a specialized form of amateur radio communications, its time proven concepts are comparatively simple and easy to understand. The Baudot code used for RTTY was developed many years ago, when the 5 necessary pulses were produced by mechanical means. Modern RTTY systems merely use electronic means for generating or decoding those same pulses.

Early model teleprinters used a constant running motor driving a shaft to which 5 or 7 cams were attached. Each cam's purpose was to provide one pulse of the Baudot code (the extra two cams and their related pulses gave "start" and "stop" bits to indicate the beginning and end of each character). The cams and their corresponding sets of contacts worked somewhat similar to a distributor and breaker points in a car, except the keyboard determined which cams would close their set of points and which would not. A chart of this keying technique is shown in **(Figure 2-1).** Assuming the key for letter "A" is pushed, contacts for bits 1, 2 and the stop bit would close and **permit** current flow (the **"mark"** condition). During this same time, contacts for bits 3, 4, 5 and the start bit would open and **prevent** current flow (the **"space"** condition). Studying the Baudot chart further, we find separate on/off or mark/space codes for each alphabetic character and tele-teleprinter function. Notice also a Baudot code set for upper case **(letters)** and lower case **(Figures).** This "shifts" for capitals, numbers and punctuation. Now let's use the previous information to visualize the overall RTTY concept.

Let's assume a modern transceiver with a rear socket for "RTTY input" is being used with a mechanical teleprinter. First the rig is switched to transmit and the carrier goes on the air (in this simplified case, the "no current"-**space** frequency is being aired). The "A" key is pressed, and the resultant pulses sequentially pass or don't pass through a relay which in turn grounds or doesn't ground (according to the bit-keying sequence of the "A") the rig's RTTY input. When that input is grounded (current through relay), a **mark** is produced. When the input isn't grounded (no current through relay), **space** is produced. The resultant Frequency Shift Keying signal (FSK) travels to a distant receiver, is converted from tones to current changes (by a demodulator), and is applied to a teleprinter's magnets. Those magnets cause the (receiving) teleprinter to key appropriate cam-driven contacts and recreate the transmitted "A." That, in the simplest of terms, is the concept of RTTY. **Mark** and **space** may **invert,** etc., but the overall concept is the same. You "old time RTTY'ers" please note this is an explanation for newcomers. It is not intended as a technical discussion nor a theory of operation on specific teleprinter models. Simplicity aids understanding. No one learns all RTTY parameters in a few sentences. . .did you? Let's continue.

Today's RTTY signals are generated by microprocessors or home computers substituting electronic

BAUDOT-CODE CHARACTER SET

Lower Case	Upper Case	Start Bit	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Stop Bit
A	-	0	1	1	0	0	0	1
B	?	0	1	0	0	1	1	1
C	:	0	0	1	1	1	0	1
D	$	0	1	0	0	1	0	1
E	3	0	1	0	0	0	0	1
F	1	0	1	0	1	1	0	1
G	&	0	0	1	0	1	1	1
H	#	0	0	0	1	0	1	1
I	8	0	0	1	1	0	0	1
J	1	0	1	1	0	1	0	1
K	(	0	1	1	1	1	0	1
L	)	0	0	1	0	0	1	1
M	.	0	0	0	1	1	1	1
N	,	0	0	0	1	1	0	1
O	9	0	0	0	0	1	1	1
P	0	0	0	1	1	0	1	1
Q	1	0	1	1	1	0	1	1
R	4	0	0	1	0	1	0	1
S	Bell	0	1	0	1	0	0	1
T	5	0	0	0	0	0	1	1
U	7	0	1	1	1	0	0	1
V	;	0	0	1	1	1	1	1
W	2	0	1	1	0	0	1	1
X	/	0	1	0	1	1	1	1
Y	6	0	1	0	1	0	1	1
Z	"	0	1	0	0	0	1	1
Blank	N-P**	0	0	0	0	0	0	1
Carr ret.	N-P	0	0	0	0	1	0	1
Line feed	N-P	0	0	1	0	0	0	1
Space	N-P	0	0	0	1	0	0	1
Letters	N-P	0	1	1	1	1	1	1
Figures	N-P	0	1	1	0	1	1	1

1 = current flow, or mark
0 = no current, or space

Figure 2-1 *Keying arrangement for the mark and space signals used in all forms of RTTY.*

actions for old time mechanical movements. When an "A" key is pressed, for example, the computer refers to a programmed table and "looks up" the appropriate 7 bit Baudot code (remember there are 5 information bits plus a start and stop bit). The resultant time-sequential binary level voltages are applied to a voltage-dependent audio oscillator: binary 1's produce either a low frequency mark tone (or higher frequency space tone) while binary 0's produce the other tone. Since the audio oscillator is caused to switch between two frequencies, the technique is called Audio Frequency Shift Keying **(ASFK).** This signal (which may be compatible with older mechanical systems) is then transmitted to the distant receiver. The receiver reproduces **ASFK** tones which are directed from a speaker to a demodulator unit. The frequency-shifting tones are then converted to voltage or no voltage pulses (Binary 1's or 0's) which are directed to the microprocessor based or home computer system. Timing functions being controlled by start and stop bits on each character, the system then refers to a translate table and "looks up" the appropriate character for each 7-pulse train. The located character is processed and displayed on the video monitor. We've covered a substantial amount of ground in the previous discussion: **Mark/Space, FSK, AFSK,** audio modulators and audio demodulators. Let's now delve slightly deeper into these parameters and bring their full meaning into focus.

SHIFTS, TONE POLARITIES AND SPEEDS

There are three possible variables associated with any RTTY signal: the employed two-tone frequency shift, the teletype speeds, and the polarity of mark and space tones. Once these variables are understood, an RTTY signal can be tuned with the same ease as tuning an SSB signal. Determining which parameter is being used in each case can be done sequentially, providing smooth reception and copy within seconds after the signal is originally heard.

During the early days of RTTY, comparatively unstable and less selective equipment inspired the use of **"wide" shifts** of 850 Hz between mark and space tones: mark at 2125 Hz and space at 2975 Hz. As the stability and selectivity of amateur gear improved and SSB techniques came into vogue, a **"narrow" shift** of 170 Hz became the widely accepted standard. The frequencies used for narrow shift are: mark at 2125 Hz and space at 2295 Hz. Notice that only the space frequency changed, and that "frequency compactness" will pass through SSB gear with 2.1 or 2.4 kHz filters. While the majority of amateur RTTY activity is in the narrow shift category, wide shifts have not been completely forgotten. These signals are still employed by many amateurs using Frequency Shift Keying ("swinging" a rig's carrier oscillator) rather than Audio Frequency Shift Keying (directing the RTTY tones into the mike circuit of an SSB rig). Finally, it should be mentioned that most commercial RTTY news and press services employ 425 Hz shifts: mark at 2125 Hz and space at 2550 Hz. If you're interested in receiving only 170 Hz amateur RTTY, a "fixed frequency" RTTY demodulator will serve quite effectively. If, however, you prefer the ability to receive 170, 425 and 850 Hz shifts (plus any "oddball" shift between these ranges), an RTTY demodulator which includes both "fixed" and "tunable" tone demodulation is necessary. These units usually include both preset filters for 2125 and 2295 Hz plus a separately tuned filter which adjusts from 2130 to 3100 Hz. Switching to "tunable operation" thus doesn't upset filter adjustments for popular 170 Hz shifts. It does permit, however, receiving numerous RTTY services which are extremely interesting and informative.

All of the previously described RTTY parameters are classified as the **"high tone"** standards which are used almost exclusively on the American Continents (and many other areas). There is also a **"low tone"** standard which is popular in Europe. This arrangement places mark at 1275 Hz and space at 1445 Hz: still a 170 Hz shift, and/or 1275 Hz mark with 2125 space for 850 Hz shift. Since American and European shifts are identical and modern rigs employ R I T circuits, the two standards are fully compatible on CW or SSB mode equipment (FM or AM would, however, necessitate transmitting precise frequency tones). Bear in mind, also, there are **many** non-amateur RTTY stations presently using non-standard shifts. . . .and their reception requires a tunable-space demodulator.

Although most RTTY stations employ **normal** tone polarities of **mark** at the **lower audio frequency** and **space** at the **higher audio frequency, reverse** tone polarities are encountered on a rather surprising average. **Reverse** RTTY toning situates **mark** at the **higher** audio frequency and **space** at the **lower** audio frequency. This isn't a big problem, as most demodulators include a normal-reverse switch which "swaps" tone detector outputs to put things back in order. If your particular RTTY demodulator doesn't include a **normal-reverse switch,** you can reverse the received signal by switching to the "other sideband" and slightly retuning. If you are communicating via RTTY and using AFSK with an SSB transceiver, re-

member your "opposite side band" transmission will also produce reversed RTTY tones. Most amateur RTTY communications employ Lower Sideband. How, other than using AFSK and the "opposite" (Upper) Sideband, may reverse amateur RTTY be produced? Often this occurrs when wiring a FSK relay for use with a "deluxe" transceiver featuring an RTTY keying input. Since most relays include normally open, common and normally closed terminals, simply wire them for **mark** as the lowest audio frequency. . .that closest to the (suppressed) carrier frequency. More details on that statement later.

The speeds employed for RTTY communications are 60, 67, 75 and 100 words per minute. Sixty wpm is by far the most popular amateur speed, with 100 wpm occasionally being used among computer-based enthusiasts. Sixty-seven wpm is the most popular speed for commercial news services, with 75 wpm seldom being used. Most amateur and commercial RTTY uses normal tone polarity. A listing of these parameters is presented in **(Figure 2-2).**

Older model mechanical teleprinters usually have an easy-access lever for "gear shifts" to permit 60, 67 and 75 wpm speeds. Newer mechanical units usually include 60, 67, 75 and 100 wpm in their lever selections. Speed selection with microprocessor based home computer RTTY systems is accomplished by keyboard commands such as A=60 wpm, B=67 wpm, etc., or via "special function" keys such as F5=60 wpm, F7=67 wpm, etc. Translated to computer terms, we say speed selection is under software control (programming) while tone shift demodulation is under hardward control (the transceiver to terminal interface or terminal unit).

FSK AND AFSK

As briefly mentioned earlier in this chapter, there are two possible methods of producing dual tone RTTY signals with modern amateur gear. Frequency Shift Keying **(FSK)** may be accomplished by switching a transmitter's CW output between mark and space frequencies according to the keyboard's Baudot code. This is achieved by placing a "keyed" capacitance (2-10pfd, typical) in parallel with the oscillator's main capacitor and switch it with back bias on a diode. Naturally, such circuits require

	Frequency Shift	Speed	Baud Rate	Tone Polarity	Service
A)	170Hz	60 wpm	45 baud	Normal	Amateur Radio
B)	170Hz	100 wpm	74 baud	Normal	Amateur Radio
C)	850Hz	60 wpm	45 baud	Normal	Amateur Radio
A)	425Hz	67 wpm	50 baud	Normal	News and Commercial Services
B)	425Hz	100 wpm	74 baud	Normal	News and Commercial
C)	850Hz &	67, 100, 75	50, 74, 57	Normal	Commercial, Private
D)	No-Standard Shifts	67, 100, 75	50, 74, 57	Normal	Private, Military
	Function determined by MoDem or T.U.	Function determined by teleprinter or terminal proper		determined by T.U. or sideband selection	

Figure 2-2 *Comparison of popular RTTY parameters used by amateur and commercial services. Most common formats are "A"; less popular are "C." If reception difficulties are experienced, check "reverse" tone polarity.*

technical proneness to install and adjust. Some of the "deluxe" transceivers have this feature "built-in" and merely require grounding a rear panel connection for mark/space transitions.

Audio Frequency Shift Keying (AFSK) is accomplished by directing Baudot code voltage pulses to an audio oscillator which then produces dual tones corresponding to marks and spaces. These tones (usually 2125 and 2295 Hz for a resultant 170 Hz shift) are then directed to the mike input of an SSB transmitter. Since this (AFSK) technique doesn't require any transceiver modification, its popularity and use has become the accepted trend. Indeed, the pure simplicity of AFSK setups and comparably simple RTTY tone demodulators ("all in one box" RTTY interfacing units) has been a major factor in RTTY's increased popularity.

Assuming the use of similar shifts, tone polarities and RTTY speeds, both FSK and AFSK concepts are directly compatible. The most popular shifts and speeds, you'll recall, are 170 Hz and 60 wpm. The most popular tone polarity ("normal") situates space as the **lowest RF** frequency and mark as the **highest RF** frequency. This is accomplished by using **Lower Sideband** for RTTY operations. If the previous statement seems confusing (in the fact mark is 2125 HZ and space is 2295 Hz), remember frequencies nearest a carrier (or in the case of SSB transmission, the suppressed carrier) are the lowest modulating frequencies. Since LSB is used for RTTY communications, the lowest RF signal (highest audio frequency) is space. All of the popular SSB transceivers perform quite smoothly on AFSK RTTY: their bandwidths easily pass 2295 Hz and the LSB mode is front panel selectable. Remember, however, the duty cycle of RTTY is a full 100 percent. The SSB transmitter's output should be reduced to **at least** 50 percent, with a 75 percent reduction being highly desirable. . .especially for long transmissions. The mike gain should also be kept quite low to avoid possible tone distortion.

AMATEUR EQUIPMENT CONSIDERATIONS

Commercially manufactured amateur radio gear has changed and improved significantly during the last decade, and these expansions are particularly attractive to RTTY enthusiasts. Modern transceivers eliminate the need for larger room-filling rigs, and front panel adjustments of bandwidths, IF center frequencies, etc., reduce the need of digging into a unit's circuitry for optimizing adjustments for specific modes. The receiver section of almost any popular SSB transceiver exhibits ample sensitivity for RTTY operations. Indeed, finding a terminal unit capable of that equivalent calibre in performance can be a challenge.

The prime features to consider in a receiver being used for RTTY are selectivity, passband tuning or IF shift, and RIT (if the unit is a transceiver). While normal SSB mode bandwidths are suitable for "usual" and/or non-DX RTTY work, the ability to narrow the receive bandwidth and avoid QRM is quite beneficial. Simply narrowing bandwidth without retuning IF center, however, can cause a loss of the received RTTY signal. Assuming a 2.1 kHz bandwidth is being used, the receiver's frequency response is 300 to 2400 Hz. Mark and space tones of 2125 and 2295 fit within the upper part of that range, but the IF's center needs to be shifted up near 2150 Hz (merely reset passband tuning). If a 500 Hz filter is used without IF shift, the receiver's output will typically be 700 to 1200 Hz. Using IF shift permits moving that 500 Hz range near 1900 to 2400 Hz, thus passing RTTY signal (and reducing adjacent channel interference). The narrow bandwidths and precise frequencies associated with RTTY place stringent requirements on equipment stability, however, modern gear is quite capable of that performance.

As previously mentioned, the duty cycle of RTTY is a full 100 percent: the same as holding a key down for the full period of a CW transmission. This places an excessive burden on transmitter "finals" (tubes or transistors), power supply components and antenna elements (such as traps). Obviously, RF power output must be decreased (by reducing the AFSK level directed to the transmitter's mike input; not by reducing loading of the final amplifier). While some manufacturers specifiy reducing power levels to ½ of maximum specifications, we suggest further lowering that figure to provide a comfortable margin of safety. A 100 watt output transceiver driving a 1 Kw input amplifier and using a 1 Kw rated antenna, for example, typically produces 500 watts output. The **maximum** RTTY output should be set between 125 and 250 watts. The results of using 125 rather than 250 watts will be miniscule on-the-air signal difference, but substantially longer component life in the amateur gear. Keep a close check on transmitting tubes and/or transistors. Remember the cooler a device runs, the longer its lifespan.

When interconnecting units in an amateur setup for RTTY, remember to use a common ground independent of rig cables or AC lines. The best way to accomplish this involves placing a copper strap on the operating desk's rear, connecting the strap to an earth ground via short, heavy wire and then connecting each item to the copper strap via a short and heavy jumper. This "independent

ground" will reduce stray hum, RF feedback, etc., quite effectively. **(See Figure 2-3).** Occasional difficult cases of hum in video monitors, interfaces, etc., can be cured by adding .01 mfd capacitors bypassing "each side" of the AC line of the affected unit to ground (the copper strap). Beyond these points, each setup will have its own idiosyncracies which are best solved through patient and persistent individual efforts. Each case is different.

RTTY OPERATIONS

While amateur RTTY bears a similarity to other modes of communications, it also reflects its own particularly unique characteristics. Becoming familiar with these "facts of life" before actually transmitting on the air ensures smooth and respected operations. Naturally, the first of these considerations is monitoring transmissions from other amateurs. Notice how each station identifies on CW at the beginning and end of each transmission (a previous F.C.C. requirement). Notice how a new on-frequency station begins with "QRL?" (is this frequency in use?) before blatantly pouring out a CQ which could disrupt other QSO's. Notice how one or two lines of CQ's is quite sufficient without ruining the frequency for all. Now let's consider some of the not-so-apparent aspects of good RTTY operating.

Since some RTTY transmissions can be quite lengthy, simply monitoring before calling CQ may not be sufficient. If a brief "QRL?" doesn't bring any response, switch on your RTTY signal, ID, tap a single CQ, then ID again and listen closely once again. If a response or a "QRX" (please wait) isn't heard, you can then feel free in giving a "full CQ." Remember, however, a prospective replier would like a chance to answer before falling asleep or leaving the rig for dinner.

If you are using AFSK, remember to keep **mike gain low**. Otherwise, tones will be distorted, spurious emission will be generated and excessive side splatter will be produced. A number of popular rigs include both RF output and mike gain adjustments. Rather than reducing RTTY power with the RF output control and leaving the mike control at its normal setting with these rigs, we suggest leaving the RF output high and reducing output power by **lowering mike gain.** The resultant (same reduced

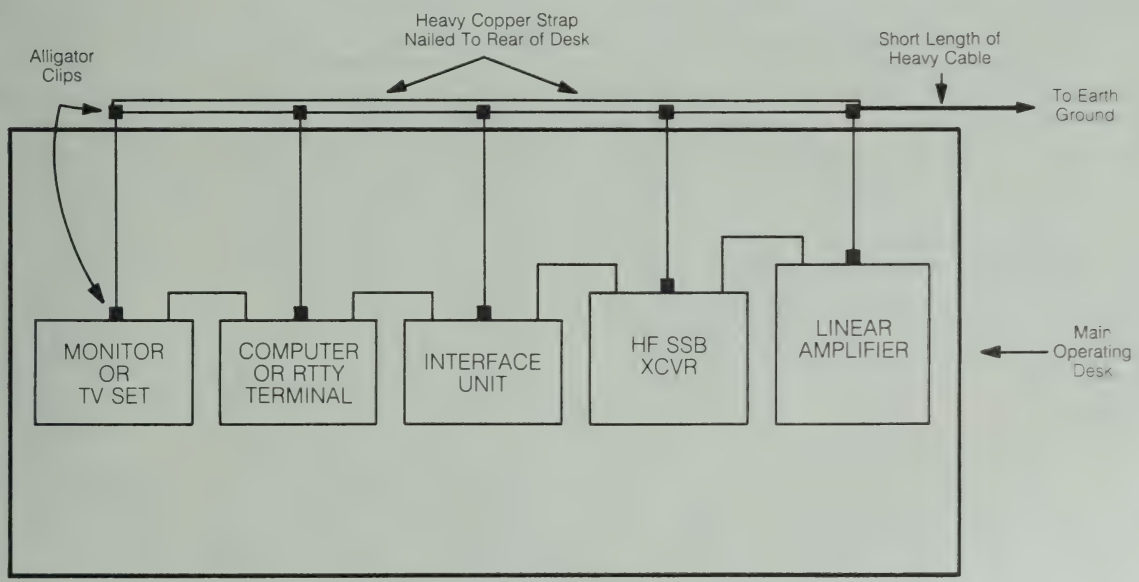


***Figure 2-3** Method of installing an independent grounding system. Each piece of equipment is connected to copper strap via a short length of flat copper braid fitted with alligator clips. Note: These grounds are separate from any interconnecting cables or wires (such as mike cables, RF cables, etc.).*

output) signal will be clean and pure. Monitor output closely until familiar with this technique. AFSK tones feeding the transmitter could possibly change levels, causing excessive output power (a rather rare occurrence, but it's beneficial to know). Finally, check the quality, calibration and stability of your signal on a separate (and high quality) receiver. A nearby amateur may also prove useful in this measure. Maybe the two of you could "swap shacks" for a couple of hours to evaluate your own signals from "the other end."

As this book is being written, the majority of amateur RTTY activity is being conducted on 20, 40 and 80 meters. This doesn't mean RTTY activity on 15 and/or 10 meters is discouraged (indeed not! Let's see more activity on these clear and quiet bands!). Illogical as it may be, RTTY operators seem to "clump together" on (overworked) 20 meters rather than moving to more peaceful grounds.

A list of RTTY allocations for the amateur HF bands is shown in **(Figure 2-4).** Most of the activity is on 20 meters, with 40 meters enjoying "second popularity." RTTY DXing is popular on 20 while message storage nets and electronic mailboxing is a popular afternoon activity on 40 meters. 80 meter RTTY is usually a pleasant "cross" of operators and interests. As mentioned, 10 and 15 meters are excellent choices of RTTY activity for those tired of "the fast life." The author recalls making his first RTTY contacts on 10 meters several years ago: they were choice DX contacts which netted many envious compliments. Unfortunately most of those early contacts ended when the DX operator grew impatient. The author's typing was terrible, and the speed was below 2 words (pecks) per minute! Although there's a limit to anyone's patience, amateur RTTYers are unquestionably the most patient, considerate, helpful and friendly group in amateur radio. They're great for helping budding RTTYers.

Amateur Radio RTTY Frequencies in the HF Band

80 Meters	3600–3650 KHz
40 Meters	7075–7100 KHz
20 Meters	14075–14110 KHz
15 Meters	21075–21100 KHz
10 Meters	28075–28100 KHz

Regardless of the band in use, Amateur RTTY is normally transmitted with the space tone being the lower frequency on the air. This requires that the transmitter be set for lower sideband with standard U.S. high tone RTTY equipment.

***Figure 2-4** RTTY allocations for amateur HF bands.*

SPECIALIZED RTTY FUNCTIONS

There are several unique capabilites which may be included or added to a modern RTTY setup, thus we will briefly consider those functions for your knowledge. Remember, these are essentially options which can be "mixed or matched" as desired.

USOS, or **UnShift On Space,** is used on electronic terminals for closer compatibility with older model teleprinters. Those mechanical units included keys for letters and figures which selected appropriate cased-characters. Typing call letters, for example, was K (Figures) 4 (Letters) TWJ. Using **USOS,** the modern terminal thus interprets a "space" Baudot code as a "switch from numbers" (example: K (numbers) 4 (space) TWJ). This **USOS,** concept has become universally popular, and results in smooth communications between various units. Lacking **USOS,** the "electronic terminal" will continue in figure printing mode until a "letters" code is received. With **USOS,** the terminal will eventually (at the first space) return to printing letters.

During past years, a system known as **autostart** was used by many RTTY devotees. Essentially this entailed leaving the station's receiver monitoring a certain frequency while the interconnected teleprinter provided a hard copy of any monitored activity. The operator could then "read the mail" (literally) at his convenience. The disadvantage of this setup (if it could actually be classified disadvantageous) was abrupt "startups" during wee hours regardless of the intended receiving party(s).

Following autostart popularity, another system known as **Selcal** came into vogue. This arrangement is similar to autostart, except a specific user terminal is "selected" to be energized. Electronic terminals are utilized, and constant-frequency monitoring is employed. When the designated access code or password is received, the terminal goes into action and stores the incoming message.

Finally, the upcoming mode of electronic mailboxing, or E-mail, promises an exciting future for all printed word communications. This arrangement, which is easily spotted on 40 meters during afternoon and early evening hours, permits exchanging two-way messages without direct operator intervention. Essentially, "Station A" generates a message and leaves it in its terminal's electronic mailbox for polling. Later, "Station B" calls (unattended) "Station A," exchanges proper ID's and preestablished passwords. Following that sequence, "Station A" automatically transmits its "mailboxed messages" and standby for return messages. "Station B" may then place a reply in "Station A's" mailbox, etc. Sometimes, third parties act as the electronic mailbox proper. This setup thus permits message exchanges between other amateurs with conventional RTTY or ASCII systems. The

only prerequisite is knowing proper accessing/using codes and passwords. Electronic Mailboxing will be included in upcoming, long range OSCAR satellites. This consideration will permit amateurs around the world to communicate at their convenience rather than during specific band openings. . .a true innovation and grandstand beginning for data packet networking.

AMTOR

During January, 1983, the F.C.C. officially approved the error-correcting code of **AMTOR** for amateur radio operations. **AMTOR** (Amateur Teletype Over Radio) was initially derived from the commercial system SITOR (SImplex Teletype Over Radio); the difference being several stations can monitor AMTOR while SITOR is usually conducted only between specific operations.

AMTOR works on the principle of changing each 5 digit Baudot (RTTY) character to a 7 digit character which is always comprised of four 1's and three 0's. Being transmitted in this format, the receiving terminal constantly checks for a 4-and-3 combination before accepting each character as correct. If the 4 to 3 ratio doesn't appear, that characater is "thrown out" as "incorrect." As mentioned in Chapter 1, conventional tones and shifts are unchanged. Data bit manipulations are handled by computer based systems. The only stipulation involves automatically requesting repeats, if that feature is used.

There are two basic forms of AMTOR communications: ARQ, or Automatic Repeat Request (also known as mode A), and FEC, or Forward Error Correction (also know as mode B). Both of these forms use 170 Hz RTTY shifts and 7 bit characters. The bit arrangements for AMTOR are different from RTTY, however, these RTTY setups will not decipher AMTOR signals.

When the ARQ mode of AMTOR is used, only 3 characters are transmitted at a time. The receiving station must then switch to transmit and send a brief "acknowledge" or a "not acknowledge" signal to the other station (which simultaneously switches from transmit to receive and listens for those replies, or "chirps" as they have affectionately been named). Following that exchange of signals (which, incidentially, encompasses only 350

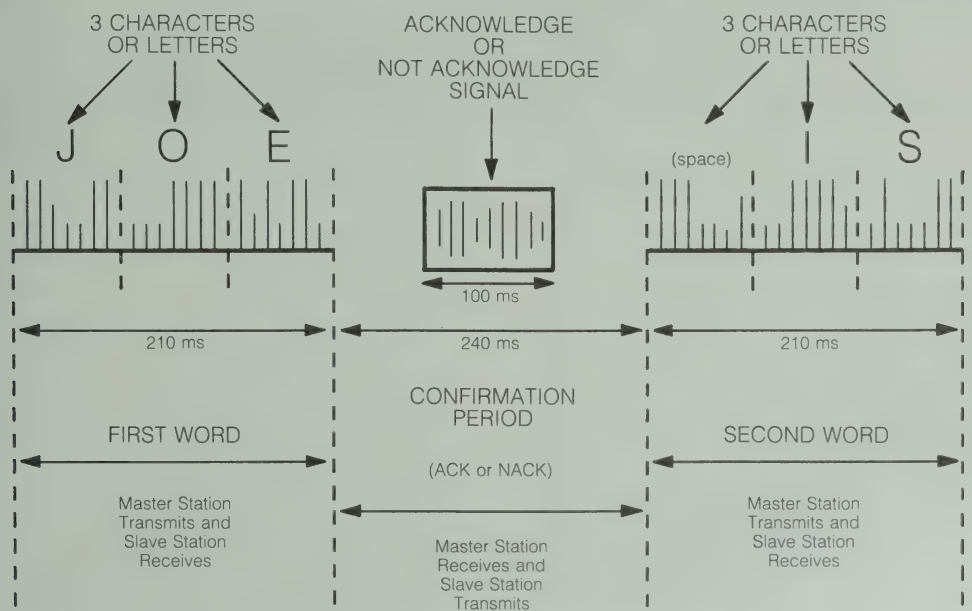


Figure 2-5 *Basic outline of the ARQ concept of AMTOR. Each "3 letter transmission" must be confirmed as "good" or "bad" before the next 3 character group is transmitted. The overall results are nearly error free copy.*

milli-seconds), the next three character burst is transmitted. A clarification of this concept is illustrated in **(Figure 2-5).** AMTOR mode A is basically a "one to one" form of communication, however "ARQ listen" modes are included in commercially manufactured terminals. Essentially, "ARQ listen" merely copies transmissions from the master transmitting station without generating its own acknowledgement signals.

The Forward Error Correction mode of AMTOR employs the concept of transmitting each character cluster twice. Receiving stations merely use microprocessor or computer controlled systems to "vote" on the character pairs and output a single resultant display of the results.

As this book is being written, the bulk of AMTOR activity is being conducted around 3,637 kHz and 14,075 kHz. It's also interesting to note that electronic mailboxing with AMTOR (FEC mode) is coming in vogue, with message store-and-forward techniques also being utilized. As a means of measuring AMTOR's acceptance, we suggest comparing present activity to that as of this writing. AMTOR interest is surely growing, and the leading amateur radio manufacturers are bringing many new AMTOR units to the market.

CHAPTER 3

STRAIGHT TALK ON HOME COMPUTERS

Recently, the personal home computer has become one of the world's most popular items. Indeed, this small and versatile unit was designated The 80's "Man of the Year" by Time Magazine. Complimented by such "high technology" promotions and decreasing retail costs, the home computer craze has thus reached a level of epidemic proportions.

Although few people would purchase an amateur radio transceiver if they were unfamiliar with ham radio, or an automobile if they didn't know how to drive, nearly everyone has considered purchasing some type of home computer. General public presentations lead us to believe these computers can perform almost any function in something of a "magical" manner, but such isn't necessarily the case. Computers are quite operation-powerful and versatile items, but they must be programmed for specifically-desired functions. Lacking that programming, the computer is little more than a blank box which is "capable but undirected." It should also be realized that any computer is no more capable or intelligent than its programming, or software. Recently, for example, a typically-informed individual decided to use a home computer for teaching fellow church members facts of the bible. After being informed the blank computer didn't possess that knowledge but had to be programmed, he questioned the possibility of self-programming the unit. Once again he met obstacles in the revelation that if he programmed 50, 100 or even 200 questions and answers into the computer, it still wouldn't be able to handle all queries on the bible, but only recall the originally programmed questions and answers. The project was abandoned when the individual realized more than a lifetime's programming would be required to accomplish the desired results. **Moral:** a computer functions according to, and only according to, its associated software. Fortunately, that stipulation doesn't necessitate each of us to understand the intricacies of computer programming: unlimited and ever-expanding amounts of software in every imaginable field are available commercially. One merely "loads and runs" the operations or activities of his choice (and possibly learns how to self-program at some later date). Computer software is available in several forms, the most popular of which are ROM (read only memory i.c.'s) cartridges, cassette tapes and floppy disks. ROM cartridge programs hosting everything from arcade-type computer games to RTTY operations plug directly into a home computer's game port while cassettes and disks require their associated accessories, (known in computer language as peripherals. (The computer is visualized as being the center of activity, with its support items placed around outer perimeters). Few computers are used in their "stand alone" form, as this requires complete programming from the unit's associated keyboard. . .and that information would be lost when the computer is switched off. The availability and selection of proper peripherals is thus a prime consideration for neophyte home computer enthusiasts.

CONNECTING VIDEO DISPLAYS

The home computer employs as a display, or readout device, either a conventional home television or a video monitor. At least 90 percent of the home computers include a television modulator which converts internal baseband audio and video signals into an RF signal in range of commercial television's channel 2 or 3. The resultant output is directed to a television's VHF antenna terminals and is tuned in the same way as a regular television station's signal. Some home computers (such as Atari) include the television modulator within their cabinet. Others (such as the Commodore 20) place this small box external to the computer proper. The differences needn't be a source of confusion, provided one understands that baseband video and audio (the signals in "raw form" before they are applied to modulator) are 30 Hz and 3 MHz bandwidth and 20 Hz to 20,000 Hz bandwidth respectively and after the modulator the combined signals encompass a 6 MHz (TV) channel near 60 MHz. Some people have unknowingly tried to connect baseband video (and audio?) to the antenna terminals (RF input) of a regular

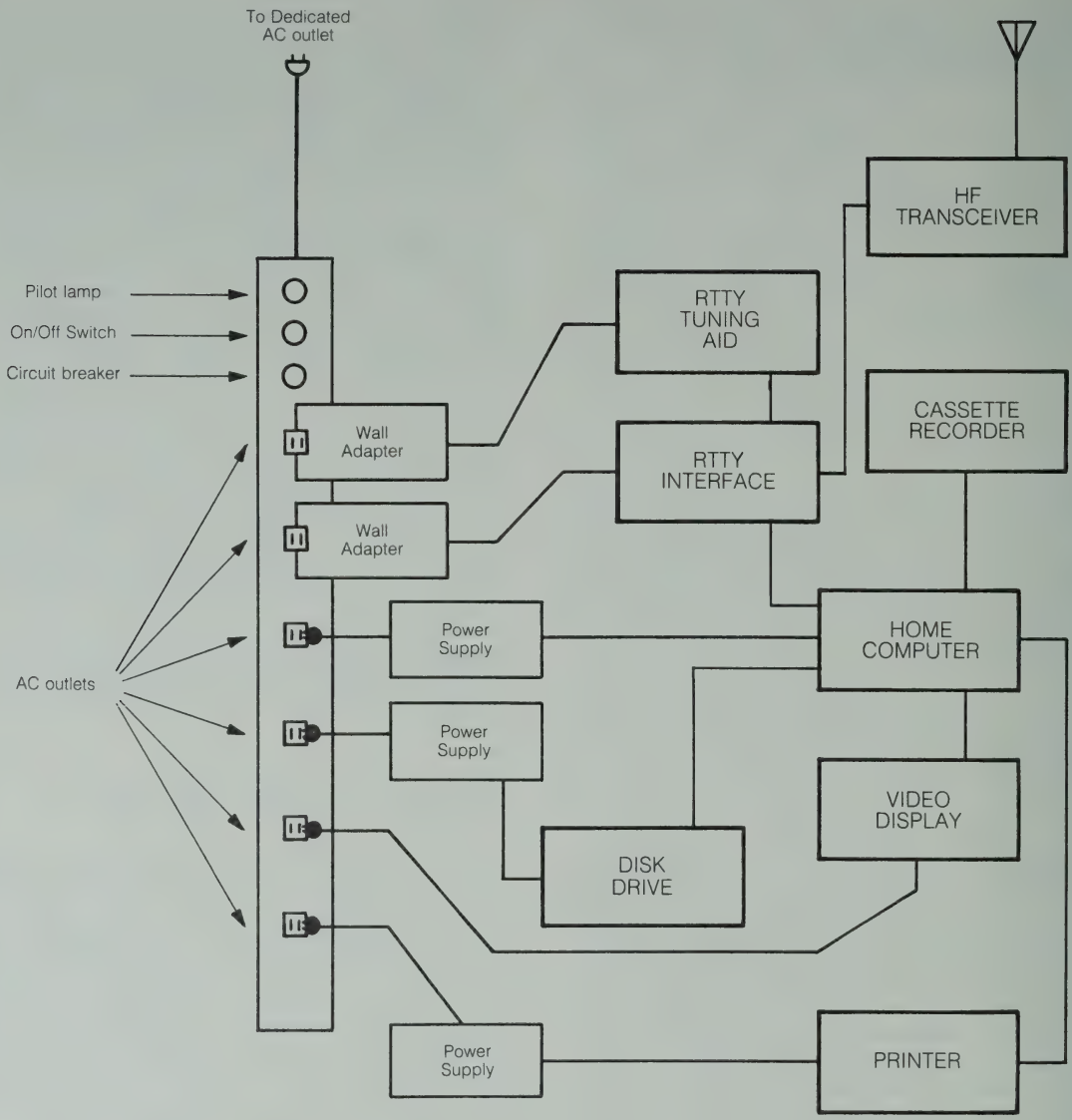


Figure 3-1 *Example of AC wiring arrangement for a home computer and RTTY setup. Use of switched multi-outlet strip permits energizing complete systems with a single switchthrow. This arrangement also prevents each unit's power supply from heating when not used (see text). An AC outlet capable of handling total system current should be utilized.*

television and wondered why it didn't work. Quite honestly, this low frequency signal is far removed from the tv's tuner and IF range. It simply can't tell there's a signal at its input (this baseband signal is produced much later in the television's circuitry, at the detector).

Another frequently encountered problem occurs when a home computer's modulated RF output is directed to the video input of a closed circuit-type television monitor (this unit is easily distinguished from a regular television in the fact it does not have a channel selector or tuner). Here, the problem is reversed from the previous example but the results are similar: a non-usable visual display. In this case, one is attempting to apply an approximate 60 MHz channelized signal to an input which accepts 3 to 4 MHz (or up to 6 MHz if the monitor is capable of high resolution). The 60 MHz (RF) signal is far above the monitor's (baseband video) range, and consequently the monitor doesn't know a signal is connected to its input. The previous problem is easily and quickly solved by merely checking the home computer's manual for pinout connections of video or RF and then wiring or purchasing a suitable cable.

GENERAL STRUCTURE OF HOME COMPUTERS

The usual inexpensive home computer system consists of several "boxes" of various sizes and shapes, some of which require external power sources. The computer unit proper is usually the size of a conventional typewriter, but lacks an upper movable carriage area. An external power supply or AC transformer unit is usually employed, connecting to the computer via a special plug and jack arrangement. Since the computer's on/off switch is on the output side of its power supply, it is advisable to add a switched AC strip or unplug the unit from AC mains when not in use. While smaller computer peripherals such as the modulated tv oscillator, cassette recorder, etc., may obtain operating power from the computer's supply, larger peripherals such as disk drives or printers require separate power sources (This same situation holds true for many RTTY interfaces: the power supply being associated with the popular "wall adapter" arrangement.) As a means of handling this type structure, we suggest using a switched, fused and transient protected multi-outlet AC strip for power distribution within the computerized RTTY system. An example of this arrangement is illustrated in **(Figure 3-1).**

Almost every home computer employs only one memory expansion or game port. Since the power supply furnished with these units operates near its maximum rating, this measure seems logical to prevent uninformed users from purely overtaxing the system. Recently, however, several independent companies have begun producing expansion port Motherboards. Basically, these items contain 3, 4, 5 or 6 parallel-wired expansion sockets on a small "mainframe-type" p c board which directly plugs into a home computer's expansion port. It's amazing how much abuse and overheating a small power supply will stand before "meltdown!" While some people report adding up to 64K additional memory in this manner (plus a house fan blowing on the poor power supply), the technique should be approached with extreme caution. If additional memory is added in this manner, we heavily recommend using CMOS chips or powering the added memory from an external source. Motherboards do have merit, however, for setups sequentially using various ROM cartridges (such as RTTY, home business programs, arcade games, etc), exchanging cartridges plugged vertically into a Motherboard is usually much easier than moving a computer and awkwardly pulling at a programming cartridge. **(See Figure 3-2).**

Some home computer systems "Daisy Chain" all peripherals together, while others use separate connectors for each additional unit. While the "Daisy Chain" arrangement usually results in neater setups, neither technique has a technical advantage of significant value. A sample "Daisy Chain" system is shown in **(Figure 3-3).**

COMPUTER MEMORY CONSIDERATIONS

There are two types of memory i.c.'s in home computers: RAM and ROM. RAM, or Random Access Memory, relates to the computer's "working memory." This section accepts and manipulates information during its operations. ROM, or Read Only Memory, relates to "fixed and non-changeable memory" which the computer employs for execution of its various functions. Data operating with an external item such as an RTTY interface is handled by a computer's RAM chips while internal actions of the computer (such as data clocking, activation of various buss lines, etc. . . things which do not change regardless of the computer's operations) are handled by the computer's ROM chips. Each time a different program or game is loaded into the computer, the RAM information is completely changed.

Early model home computers were factory supplied with a miniscule amount of RAM. . .usually 2 or 5K bytes. This amount of memory was sufficient for simple programs and basic RTTY operations, but such "frills" as canned messages and type ahead buffers were limited in

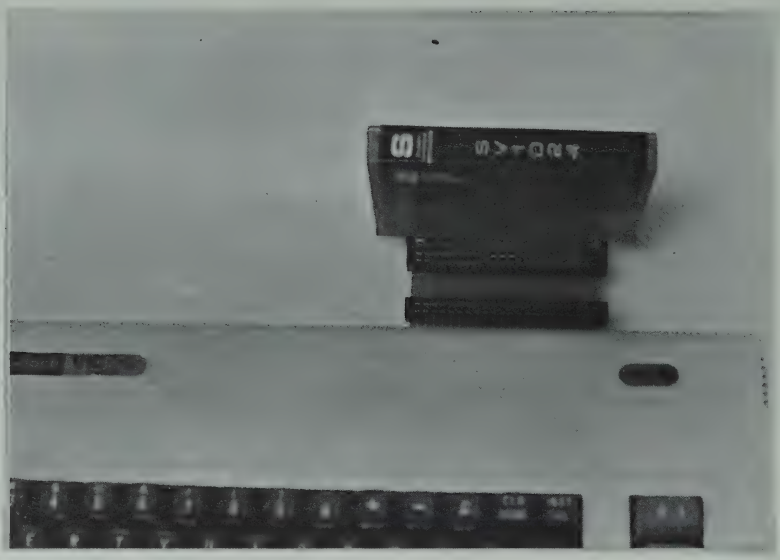


Figure 3-2 *Expansion Motherboard holding a 24K CMOS memory cartridge plugged into game port of a Commodore VIC-20 Computer. CMOS card may easily be removed and replaced with an RTTY programming cartridge.*

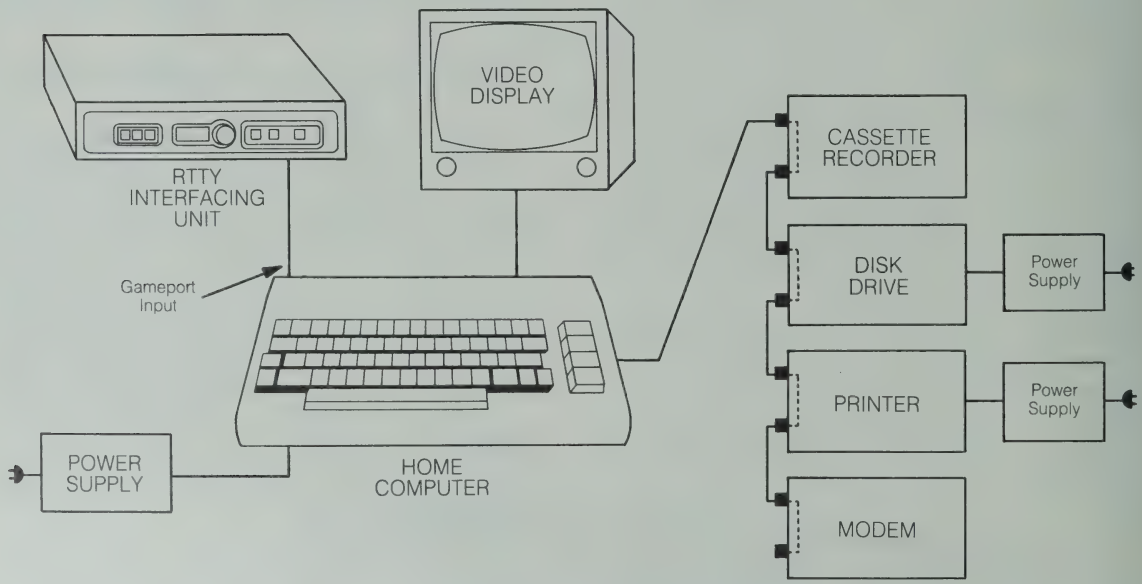


Figure 3-3 *Example of a "Daisy Chain" setup of Computer peripherals. Signals addressing various units "normal through" unaffected units without consequence, thus access time is same as parallel connected units.*

content when less than 5K of memory was used. As time progressed, additional amounts of RAM were included in home computers: 5K bytes, then 16K, 48K and most recently, 64K bytes (the Commodore 64 is an example of a 64K byte computer). What exactly does this mean to the RTTY-enthused radio amateur? Nothing earthshattering, as most of the popular RTTY programs. . .even those with type ahead buffers and programmable message ports (canned messages). . .usually run on 5 to 12K bytes of ROM in a computer. The extra memory is available, but seldom put to use until the computer is reprogrammed for other functions (such as word processing, home calculations for small business, etc).

The type of programming and the manner in which it is written has a bearing, also, on the amount of memory required for a specific operation. Consider, for example, RTTY software produced for the VIC-20 computer by Kantronics, AEA and RAK. All of these software packages produce roughly the same results, but the RAK software requires adding a 9K ROM expansion cartridge. On the other hand, both the Kantronics RTTY software for the VIC 20 (5K RAM) and the VIC 64 (64K RAM) produce almost the same results. . .and either computer can perform only one activity at a time (such as being an RTTY terminal, a home business computer, an arcade game, etc.). Summarizing, we may thus conclude any computer with at least 5K bytes of ROM. . .the working memory. . .will do a respectable job in RTTY use. Additional memory is useful if additional operations are planned for the unit.

SELECTING A HOME COMPUTER

Initially choosing a home computer may seem a mite perplexing to the newcomer, but logical thinking and studying of one's needs will result in a gratifying decision. Consider your needs both presently and at future times, and try to be accurate in your judgements. Write down your thoughts, let the notes "cool" a few days, and then review them from a different viewpoint. Considering the major manufacturers and computer models which have been on the market for a period is also suggested. These units have been "proven" and "debugged." Additionally, greater amounts of software and hardware are available for those units. **(See Figure 3-4)** New model computers may seem flashy and attractive, but a lack of support

Figure 3-4 *A wide variety of home entertainment and business programs mean flexibility for computer setups. RTTY system may thus "change faces" with the simple exchange of a programming cartridge.*

software can quickly have you spending numerous hours hammering keys and debugging your own programs. It's also advisable to compare costs of software and peripherals of various systems. This can sidestep purchasing a low-priced computer and then spending a fortune to "get it going." If the system will only be used for RTTY. . .and possibly establishing some home finance records (maintained on slow speed but inexpensive cassettes). . .and maybe later printing a very limited amount of information, a simple computer/cassette/mini-printer/RTTY package is quite sufficient. If the system is going to serve "double duty" with a home accounting business (CPA, etc.), disk drives, a high-quality printer, etc. may be desirable. Considering the entanglements in moving such large systems, however, the radio amateur may come out better to purchase two computers and use the simple/inexpensive unit for RTTY.

Other considerations on home computers relate to the amount of existing memory and its (later) expandability. Today's RTTY system might thus become tomorrow's RTTY and SSTV setup. Interface capabilities should also be considered: that is; can the chosen computer be used with elaborate printers if desired. . .can the system by modem - enabled for home banking or shopping. . .can it interconnect with a planned business computer system? All of these capabilities may not be possible, but at least you have some ideas and guidelines to follow. You will also be aware of what your home computer can do, and its limitations.

Finally, we have the computer's personal attraction and keyboard feel. Most popular computers perform roughly the same. . .you'll get the same end results from Radio Shack, Commodore, Apple, Atari, etc. If a unit seems especially "you," and other features check out favorably, go for it. Personally-attractive shirts wear better than newer styled or more expensive types, right? If you're going to spend a creditable number of hours behind a keyboard, take a lesson from professional secretaries and typists. Go for a unit with a smooth feeling and "good touch" keyboard. If in doubt, ask a secretary's opinion. Now. . .ponder the previous thoughts a couple of days (separate your ideas/thoughts from the full collection presented), and make a logical decision knowing you've moved in the right direction.

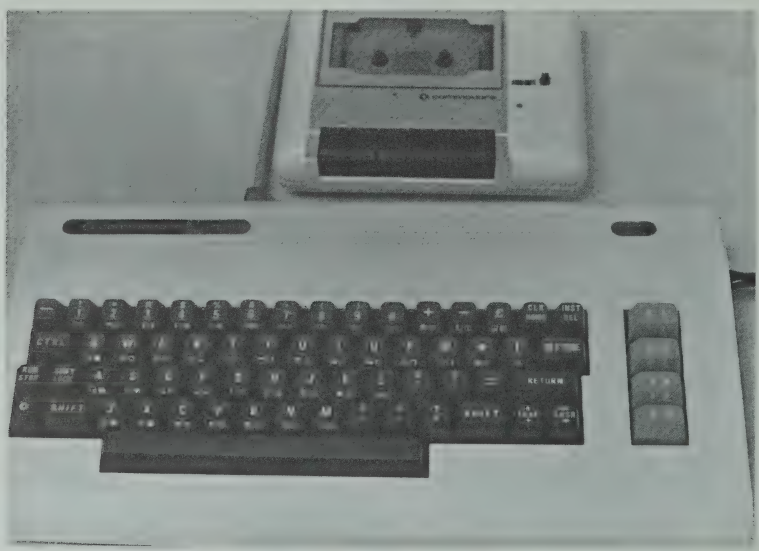


Figure 3-5 *The highly popular Commodore VIC-20 computer and optional cassette tape drive. Unit contains 5K RAM plus BASIC language. This "reference unit" leads the trend of owning a home computer.*

THE HOME COMPUTER MARKET

This is a fast-moving area that can almost give one whiplash trying to keep up with new models, expansion systems, etc. Although not meant in a derogatory manner, you can almost expect whatever system you purchase today will be superseded by next year's model. This situation really isn't a problem, however, as the "older" system still performs as it did the day it was purchased and RTTY signals themselves aren't discriminatory as to terminals. . .a working model 19. . .a HAL MPT 3100. . .an AEA CP-1 and VIC-20. . .or a Robot 800 all display the same received messages.

Previously popular and still utilized home computers include Radio Shack's Model I, II and the full-blown model III. The Model I and II were notorious for generating RF interference to receivers, and are thus losing popularity to the newer TRS-80C (called the "color computer"). Situated in the 400 dollar bracket, this computer contains 16K of ROM, interfaces to a regular TV for display, and is nationwide supported by extensive software and hardware. Since numerous amateurs own a TRS-80C, related programs are quite plentiful. The advertisement section of any recent ham magazine will confirm that statement.

Another very popular computer is the Commodore (previously known as "Pet"). Thousands of VIC-20 computers may be found in both homes and ham shacks across the country, again resulting in mass quantities of proven software and peripherals. As this book is being written, the VIC-20 (which is supplied with 5K of memory) has been "sale priced" by large outlets between 90 and 100 dollars. **(See Figure 3-5).** This inexpensive computer has thus become a widespread choice for computerized RTTY enthusiasts. The VIC-20's memory is expandable to 21K using a commercial 16K cartridge in the computer's memory expansion/game port, or a 3 slot Motherboard and 16K cartridges can expand memory to 53K (32K maximum suggested unless CMOS chips employed). The VIC-20 is a proven unit of outstanding performance.

As this book is being written, the relatively new Commodore 64 is starting its climb to popularity. This "300 dollar range" unit is supplied with 64K of memory and is compatible with most recent VIC-20 hardware. All new software is required for the 64, and thus far only small amounts of software have been introduced. Once larger

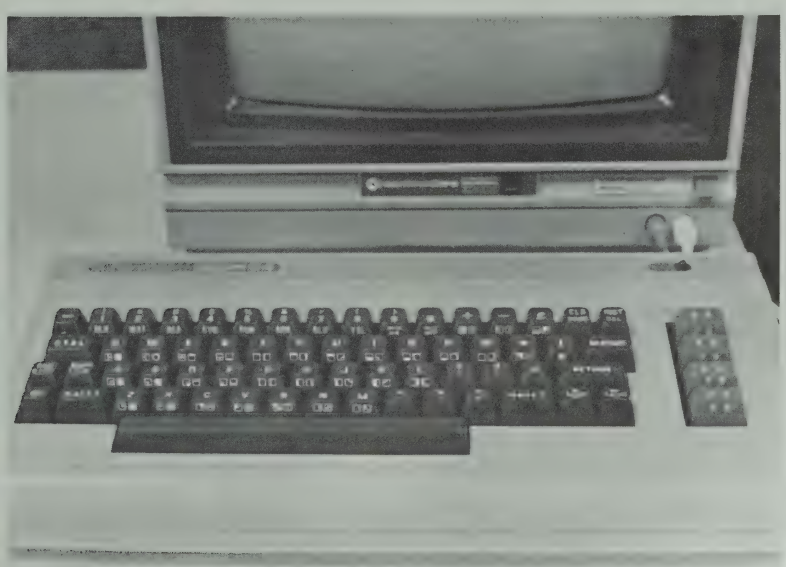


Figure 3-6 *The Commodore 64 Home Computer boasts 64K RAM and built-in BASIC language. As this book is being written, the unit is starting its climb in popularity and decline in retail cost.*

Using HamText with Commodore 64
(refer to page 60 and 61 in Commodore manual)

Computer display at power up	READY	
Operator types	POKE 53280,2 (This sets border color)(2 is "red")	Note. . .does not appear on screen
Computer Responds	READY	
Operator types	POKE 53281,4 (This sets screen color)(4 is "purple")	Note. . .does not appear on screen
Computer Responds	READY	
Operator types	SYS 32768 (Energizes HamText)	
Computer Responds	Computer enters HamText mode and becomes RTTY, ASCII or CW Terminal.	

Figure 3-7 *In response to reports of low visibility when using Kantronics Hamtext with the Commodore 64 (a light blue/dark blue display), we offer the following change as outlined. The resultant red and purple setup. Other numbers for different colors may be substituted for the 2 and 4, if desired.*

amounts of software become available, the unit's popularity should mushroom. **(See Figure 3-6 and 3-7).**

Atari's bids in the home computer market consist of the older 400, the popular 800 and the new 1200. The 400 contains 16K of memory. Its keyboard is a flat, enclosed single unit with membrane-type keys. Not a touch typist's dream, but quite useful for RTTY use, the 400 is also great for home TV games. Atari seems to be "closing out" this unit at very attractive prices (100 to 150 dollar range). Possibly the new 600XL (which hasn't appeared as of mid 1983) will supersede the 400. **(See Figure 3-8).**

The Atari 800 is an extremely good all around computer. Supplied with 48K of memory and a very professional keyboard, the 800 is adaptable to RTTY, home computing, word processing or numerous other functions. Sale prices of 800's range from 450 to 600 dollars. **(See Figure 3-9).**

Atari's recent 1200 computer boasts 64K of memory, a smooth functioning typewriter style keyboard and an attractive "low boy" cabinet design. This computer is not supplied with BASIC Language, so remember to also purchase a BASIC Language cartridge if you select an Atari 1200. Almost all Atari 400/800 software also runs on the 1200. In fact, an extensive study in this area revealed the only "troublesome software" to be disk programs. . .many of which required simultaneous use of

Figure 3-8 *The Atari 400 Home Computer features 16K RAM and flat membrane-style keyboard. BASIC isn't included, but it isn't necessary for most RTTY ROM cards. This was Atari's first all-out effort in home computers.*

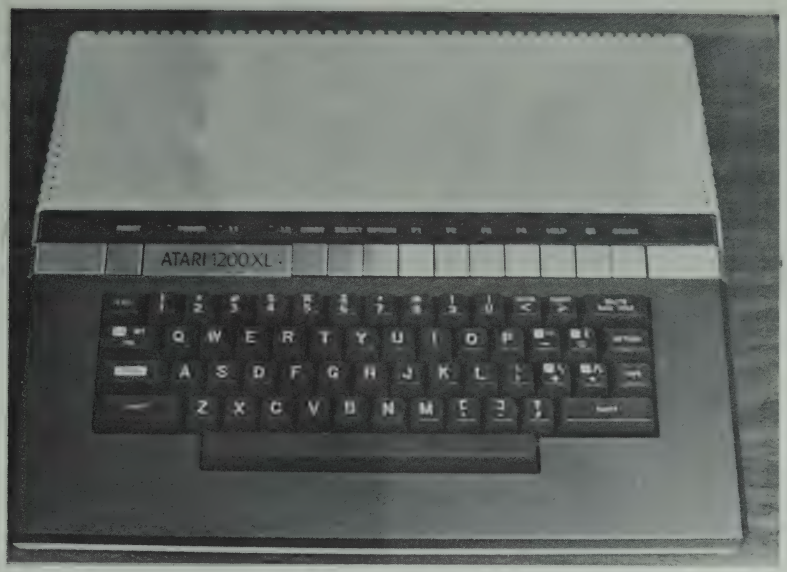


Figure 3-9 *The Atari 800 features 48K of RAM and a typewriter-style keyboard. In addition to its computer related functions, its a grand arcade game machine.*

Atari's BASIC cartridge. All RTTY programs tried ran on the 400, 800 and 1200. The usual 1200 price ranges from 500 to 700 dollars. **(See Figure 3-10).**

Several additional Atari computers are due to be introduced during late 1983; namely the 600XL, 800XL and 1400XL. Preview glances at these items reveal "low boy" designs and full-sized professional style keyboards. We understand, also, existing Atari 400/800 software will be compatible with the new Atari's, but advise you to check that at time of purchase to be sure of compatibility.

The Apple home computer are old time favorites backed by an outstanding service record and wide variety of software. Each of the units checked were clean of RF interference generation and boasted "clean" video displays. Since many radio amateurs possess Apples, related software is quite abundant.

The Texas Instrument TI-99 computer was beginning its climb to popularity and fame when, without warning, the company announced its withdrawal from the home computer field and sold the remaining stock of TI-99's at almost give-away prices.

There are a vast number of additional home computers. . .Epson, IBM Personal, Sharp, Univac Personal, Timex. . .the list is endless. Please understand the discussions herein neither endorse or denounce one computer over another, but merely provide a brief over-

Figure 3-10 *Promising an exciting future for both computing and arcade games, Atari's 1200XL boasts 64K of memory and decreasing retail cost.*

view of the home computer market. Hopefully, this information will allow a slightly more "comfortable feeling" for those of you dealing in this area for the first time. It should also be realized this area is changing, expanding, modifying and price fluctuating at a rapid rate. A few of the prices of some units were included not for cross referencing computers, but to illustrate how prices change over months and years (compare prices **then** to prices **now,** for example).

SUMMARY

Recapping the presented information, a wide variety of home computers and associated peripherals are presently available from such popular sources as Radio Shack, Apple, Commodore, Texas Instruments, Atari, etc. These relatively inexpensive units are either a regular TV set or a closed circuit video monitor for displaying information, while interfacing with the outside world via their user or game ports.

While a relatively small number of radio amateurs personally program their computers for such functions as RTTY, the majority of amateurs purchase the desired software (and often the mating hardware) from commercial sources. Since the basic computer (non-programmed; either via ROM, cassette tape or floppy disk) can be adapted for multiple functions, its in-home use is quite diverse. Remember that rigging a home computer system will require several AC outlets, and since home computers switch AC lines "after' the power supply, a separate AC outlet-switch is necessary. As one might logically surmise, there are differences in cost and capabilities between dedicated RTTY terminals and computerized RTTY setups. That choice may be influenced by seriousness, finances, and/or future plans. Select your unit according to personal desires, needs and lifestyle!

CHAPTER 4

RTTY CONVERTERS YOU CAN BUILD

There are a number of occasions when the radio amateur would like to join the excitement of RTTY today using his own personally constructed demodulator and AFSK generator units. This situation is sometimes a result of individual expression in home constructing at least some part of ones setup. Other times, this situation is brought on by financial limitations. If a home computer system is initially set up primarily for a small business application, for example, miniscule funds may remain for the computer's weekend use as an RTTY system. It's also quite possible today for a radio amateur to acquire an older model teleprinter merely for the asking and promise of a "good home." Mating with an inexpensive demodulator and loop supply, the unit may provide many hours of enjoyable returns. An FSK relay for mating with RTTY connections on a modern "Deluxe" transceiver may soon follow, providing an inexpensive introduction to RTTY. The previous saga thus illustrates the basic purpose of this chapter: home constructing some part of an RTTY system for reasons best understood by those involved amateurs.

One of the more encouraging aspects of home constructing RTTY related items involves their relatively straightforward concepts plus the case of working with DC and audio frequencies. Wire lengths and component placements aren't overly critical; indeed, perfboard-assembled RTTY demodulators and/or computer interfaces are good performers which can be assembled and aligned within a weekend's period. If the demodulator is placed inside the teleprinter's cabinet, home construction is further simplified and a "self contained system" results. More than a few amateurs have followed that "quick and easy" procedure, using double-sided tape to mount the demodulator and a small FSK-reed relay.

Loop supplies for older teleprinters are also easy to assemble and adjust for use with either 20 ma. or 60 ma. machines. A small 110 to 110 volt isolation transformer, resistor, plus two diodes and capacitors can be built on almost any type support (or even "open air wired," placed by the transformer and wrapped with tape). That loop supply can also be squeezed inside the RTTY unit for "stand alone" operation.

If you seldom tackle home construction projects and/or don't care to become involved in complex circuits or alignments, we suggest starting with a single frequency (RTTY space) demodulator. The designs are straightforward and tuneup is usually a snap. These units can be used to copy any RTTY shift (by tuning the transceiver's R.I.T) and "reverse" signals can be copied by switching the received sideband. Take time to study the planned unit's schematic diagram while visualizing the function of each stage or (if possible) each component. Don't merely "build blind" by directly copying a schematic and hoping the thing works. Although that scheme succeeds on many occasions, there's always a possibility of seeing a wire one way and wiring it another.

One home construction technique we've found quite useful (especially for those just getting started in electronics) involves double and triple checking every step along the way. The additional required time is miniscule, and there's enough confidence to place wagers on the finished unit working upon initial turnon.

First, check each and every part before beginning construction. Don't assume because a part is new that it's good. Check resistors with an ohmmeter to ensure correct values. Check capacitors to ensure "open" rather than short. If capacitor values are slightly high (above roughly .2 mfd), look for a small "kick" on the meter. Swap lead ends and check again. Use mylar or dipped capacitors: not disks. Disks capacitors can change values with temperature and are not suggested for tuned audio cirucits. Remember, also, mylar capacitors can short if their body is touched with a hot iron. Check this after soldering in their areas. Check transistors, diodes, etc. before installation, and use needlenose or similar heat sinks. Avoid using "seconds" or "bulk" devices; especially I.C.'s (which usually must be installed without checking. . .unless a friend has a socketed-circuit you might use). In other words, think! There are many means

at your disposal to ensure you're working with honest to goodness perfect parts. Then any malfunction will be narrowed to your wiring. Remember; the unit you're constructing has worked for others and there's no reason you can't expect the same results.

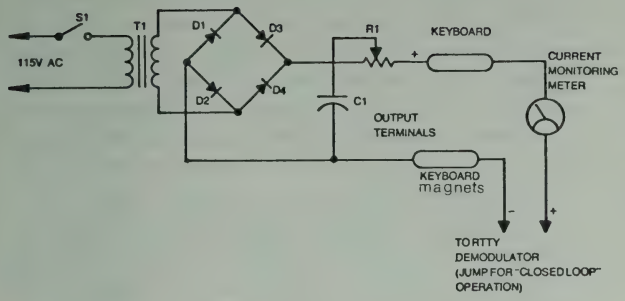
Begin assembly by laying out the checked parts and visualizing where each component will be placed. Trace wire runs and device terminals. Once you're satisfied with the layout (don't rush it. . .you want to be proud of the final results), use a felt pen to mark approximate locations of components and devices. Then clear the perfboard/circuit board and begin assembly; starting at the input and working towards the output. Pause every so often to "look ahead" and visualize how final components will lay and how much room they will require. After installing 3 or 4 components, recheck their wiring against the schematic looking not for correct wiring but for wrong wiring. Then find another "reference point" and again look for incorrect wiring. Be critical of yourself. Scrutinize. Next use an ohmmeter to check connections, but do it in the following manner. Connect one test lead to a resistor wire where it enters the resistor. Move the other test lead between wires of connected components. . .again near their body. This checks wiring **and** solder joints; continuity must be made from component to component via the soldered connections. As the circuit progresses and becomes more complex, larger number of interconnections are checked. Continue returning to those previously checked points for "reference." After adding a transistor, for example, check through a base resistor. . .through the base/collector junction. . .through the collector resistor and then proceed to the next stage. Finished building? Once again (!) go over your work with an ohmmeter checking continuities. Then when connecting the power supply, insert a milliampere meter to ensure the constructed circuit is drawing proper current. If not, consider each stage as a DC-parallel separate unit. Disconnect each and apply power while watching the meter. Let the unit itself "point" you in the direction of trouble. Defective stage found? Again temporarily remove components while watching currents. Once again being led by the unit and meter, you'll be "on track" and will surely spot some silly mistake. Remember, also, the old saying of not seeing the forest for the trees. The syndrome of overlooking an obvious problem (of which we are all guilty!) can be sidestepped by the previous "looking for something wrong rather than ensuring all is right" technique and by using another pair of eyes. . .those of a friend. Calling in assistance isn't belittling; it's logical. Sometimes that different viewpoint is the only step necessary to spot a mistake.

Armed with the previously discussed knowledge, you should experience few if any problems home constructing RTTY gear. Remember to keep an air of confidence, patience and perseverance. You'll surely succeed. . .and be a better person in the end.

A "BARE BONES" LOOP SUPPLY FOR RTTY

One of the first and necessary items required to get a mechanical teleprinter operational is a loop supply. This unit provides power to the print magnets and series connected keyboard. Interrupting this supply's connections to the magnets according to Baudot Codes then causes activation of appropriate keys and consequent printing of received messages. There are essentially two ways of interrupting the loop supply's connections; one is via the keyboard (for "closed loop" typing and current-keying an FSK relay). The other interruption is via the loop keying transistor in an RTTY demodulator (for printing received information).

Some teleprinters pulled from service may have been "haywired" in strange ways and their service information/schematic diagrams lost. If you're faced with this situation, don't panic. Locate the print magnets and check continuity with an ohmmeter. Find the keyboard's wires (2 of them) and check continuity or cam actions when a key is pressed. Next, remove all "strange" wires and merely connect the electromagnets in series with the keyboard. Upon applying power to the teleprinter's motor 'two more wires to "dig out": The motor is usually marked 110 volt AC at 60 Hz), the teleprinter should begin its familiar clatter. Disconnect the teleprinter from all AC lines and proceed as follows. Either borrow a variable voltage power supply (0 to 50 volts) or construct the loop supply shown in **Figure 4-1.** Set the variable resistor to maximum resistance as read on an ohmmeter and connect the supply's output in series with a milliampere meter, the magnets and the keyboard **(See Figure 4-1).** Now apply power to the teleprinter's motor and loop supply. While monitoring loop current, increase output voltage from the loop supply until the printer idles. A current of approximately 20 or 60 ma. (depending on your particular teleprinter) should be indicated. Otherwise, it's back to the drawing board to consider whether electromagnetic coils have opened or more "loose connections" are waiting to be found. Assuming the teleprinter is eventually made operational, check for consistent keyboard operation then "button up" the loop supply circuit. You should now be able to rapidly connect and disconnect the loop supply's positive or negative lead and cause the teleprinter to type gibberish on its paper. Bear in mind this will be the precise function of the RTTY demodulator's output transistor: to key the



D1 - D4, incl.	250 PIV, 500 mA or greater, Silicon diodes.
C1	20 to 1000 μF, 250-volt electrolytic capacitor.
R1	2500-ohm, 20-watt, wirewound resistor (with sliding tap).
S1	SPST toggle switch.
T1	110-volt primary; secondary between 26 and 120 volts, 70 mA or greater.

Figure 4-1 *A "Bare Bones" Teleprinter loop supply. Both output terminals should be isolated from ground.*

loop line with Baudot pulses.

Returning to the loop supply schematic diagram **(Figure 4-1),** we suggest the "simple and quick" approach using surplus parts. Hamfest flea markets are an ideal source of suitable items. Exact resistor value will depend on the transformer's ratings, so barter for a couple of extras in case they are needed. Large wattage resistors also ensure long life and cool operation. The 120 Hz ripple produced by the diode bridge is filtered by the single output capacitor. Since we do not listen to this signal but merely use the voltage/current to key the electromagnets, output ripple isn't a serious problem. Once the loop supply is operating smoothly, replace the milliampere meter with a series jumper and proceed to the next construction project: an RTTY demodulator.

A QUICK AND EASY RTTY DEMODULATOR

If you would like to join the action of RTTY today in an inexpensive manner, consider home constructing the demodulator shown in **(Figure 4-2).** This twin integrated cir-

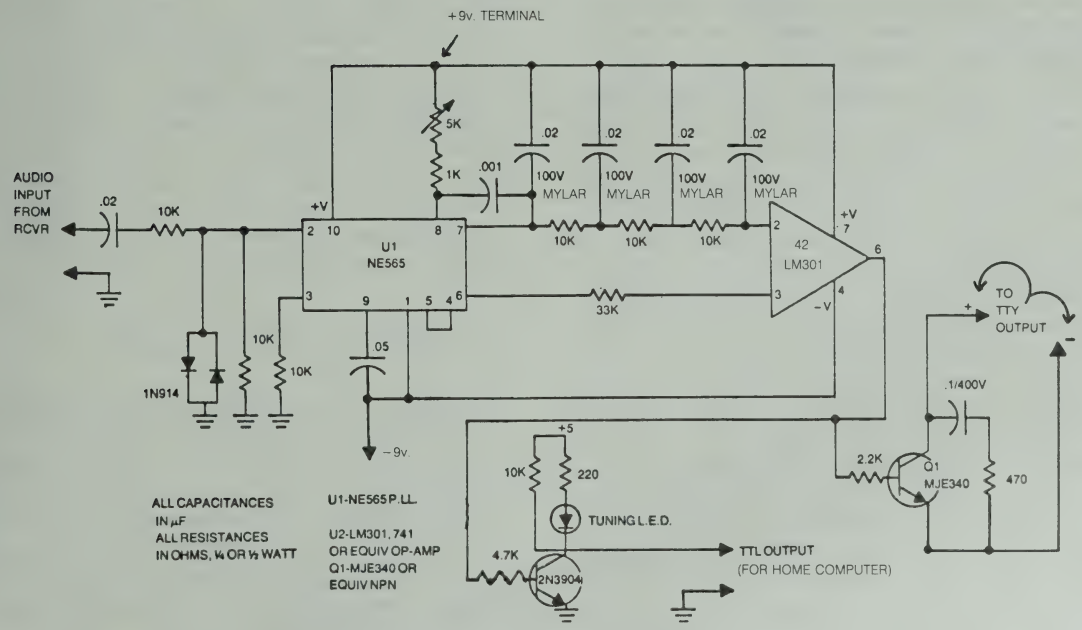


Figure 4-2 *The Quick And Easy RTTY demodulator. Unit can be used with mechanical teleprinters or suitably programmed home computers.*

cuit unit was designed by Henry Wingate, K4HAL, and an inestimatable number of them have been built and used by amateurs around the world. K4HAL recently declared his circuit "public domain," adding he hopes it helps others to join the world of RTTY communications. Our thanks and compliments to K4HAL.

The RTTY demodulator uses straightforward and easy to understand principles, detecting RTTY space signals only, but performing quite satisfactorily under reasonably good signal conditions. The NE565 phase locked loop IC is normally set to 2295 Hz for receiving 170 Hz shifts, however the receiver's frequency or transceiver's RIT can be adjusted for copying other shifts such as 425 Hz, 850 Hz, etc. The demodulator's TTL output can be used with an RTTY-programmed home computer, or loop keying of older model teleprinters is provided by the MJE340 switching transistor. The unit can be operated from two equal voltage power supplies of 9 or 12 volts. In fact, good results and fairly long battery life have been enjoyed when two common 9 volt batteries were used. Since the demodulator has a low parts count and since audio frequencies are used, point-to-point wiring on a small piece of perfboard is quite acceptable. Follow the home construction guidelines discussed earlier in this chapter, and you should have few problems with the demodulator.

Returning to the demodulator's circuit **(Figure 4-2),** let's step through its theory of operation for a concise understanding of its design. During operation, incoming RTTY signals are amplitude-limited by a pair of IN914 diodes and directed to the input (Pin 2) of the NE565. This phase locked loop IC performs a frequency to voltage conversion, providing a related voltage at its pin 7 output. This voltage is then passed through a multisection R-C filter to pin 2 of the operational amplifier, LM301. This op amp is functioning in its comparator mode (without a feedback circuit). It compares voltages from pin 6 and 7 of the NE565 and "switches" when pin 7's voltage is higher (which is when a space signal of 2295 Hz is received). The switching output transitions at pin 6 of the LM301 are then directed to the base of the 2N3904 for TTL output (+5 volts and ground) and to the base of the MJE340 for loop interruptions. The LED in series with the 2N3904 "winks" according to demodulated Baudot for tuning assistance. The .1 mfd capacitor and 470 ohm resistor between the MJE340's collector and emitter provide transient-switching protection (continuous "make/break" pulsing by MJE340 can cause spikes which will not damage the teleprinter but will destroy the transistor).

When constructing the demodulator, remember to use a low wattage iron (20 or 25 watts) and use a heat sink on the diodes and transistors when soldering. A small piece of aluminum bolted to the MJE340 is sufficient for heat dissipation during use. Capacitors should be Mylar or paper rather than disk types. If desired, a "normal/reverse" switch can be added to "invert" the wires connected to pins 2 and 3 of the LM301. Alternately, the receiver can be switched for opposite-sideband reception.

Check-out and alignment of the completed circuit is straightforward and should take only a few minutes time. There are two possible methods for tuning the NE565: we will describe both for your convenience. Connect a small audio amplifier and speaker to monitor the output of pin 4/5 of the NE565. Using a known accurate tone, adjust the 5K potentiometer until the NE565's resultant frequency is approxiamtely 2295 Hz. The NE565's true frequency may later be "tweaked" during actual reception of an RTTY signal. The second method of setting the NE565's frequency involves placing a sensitive voltmeter (1 or 2 volts) between pins 4/5 and ground, and directing a 2295 Hz tone to the circuit's input. Next, adjust the 5K potentiometer until maximum voltage is read at pins 4/5. Either of the previous techniques provide the same results: setting the NE565 to detect RTTY space signals and provide equivalent voltages between its output pins 6 and 7.

The LM301 can be checked for proper operation by monitoring input voltage changes between pin 6 and ground. Operation of both IC stages can now be confirmed with an audio oscillator (or the beat tone from a receiver's crystal calibrator) and voltmeter. **Slowly** changing the audio frequencies into the demodulator should produce gradual output voltage changes on pin 6 of the LM301. You should now be ready to connect the demodulator to a loop supply or interface with TTL inputs on a home computer system. Further ideas plus a suitable computer program are reviewed in the following chapter on RTTY Systems for Home Computers.

AN AFSK GENERATOR FOR RTTY

Following successful construction and use of your own RTTY demodulator unit, the next logical step is the addition of an AFSK generator for use with an existing HF transmitter or transceiver. You'll then be equipped for full communications on RTTY, and the resultant financial outlay will have been quite reasonable. Again we turn to the expertise of Henry Wingate, K4HAL, and thank him for sharing his design with all of the amateur community.

The K4HAL AFSK generator is designed to produce the common 170 Hz shift frequencies of 2125 and 2295 Hz. These audio tones are directed to the transmitter/transceiver's mike input for RTTY transmissions. RF output

(and any possible tone distortion) should be kept low by using the minimum acceptable mike gain adjustment. The unit employs an opto-isolator for TTL or loop keying input, thus switching transients are not troublesome. The schematic diagram of this unit is shown in **(Figure 4-3),** and its theory of operation follows. Two sections of a popular 7404 integrated circuit and a 7344 kHz crystal make up an oscillator circuit for initial signal generation. The oscillator's output is buffered by another section of the 7404 and applied to the 74193 integrated circuit. This chip performs a divide by 5 during mark condition. The output is directed to pin 4 of the "next" 74193 which divides 25 times during space condition. The "second" 74193's output (pin 6) is directed to the 4020's input (pin 10) which is a 14 stage divider operating in the divide by 128 mode. The resultant output tones (pin 6) are then buffered by another section of the 7404, passed through a dual section low pass filter and applied to the 10K output level potentiometer. From that point, the tones are cabled to the transmitter's mike input. Two additional sections of the 7404 IC are used for controlling the divide-by-N functions of the two 74193 IC's. The input opto-isolator permits mark/space keying pulses from the teleprinter of home computer to key these sections. The resultant outputs from the 7404 inverter sections then set counts on the 74193's (via pins 1, 9 and 10) to ultimately provide 2125/2295 Hz from pin 6 of the 4020.

The AFSK generator may be assembled on either printed circuit or perfboard, as desired. Assuming the same basic construction tactics discussed in the RTTY demodulator unit are used, everything should go together smoothly. Any conventional 7344 kHz crystal with reasonable tolerance may be used. Either "grind down" an old novice crystal or order an inexpensive "rock" from one of the popular manufacturers. The output level potentiometer may be placed on the unit's front panel or directly on the circuit board as desired. Remember to use mylar capacitors (except for the 24 pfd capacitor connected to the crystal). If the unit produces an output signal but doesn't shift frequency with keying, reverse connections to the opto-isolator's input. Remember to watch RF output (the duty cycle of RTTY is 100 percent), and check signal purity on an external receiver. Finally, enjoy your new RTTY communications capabilities!

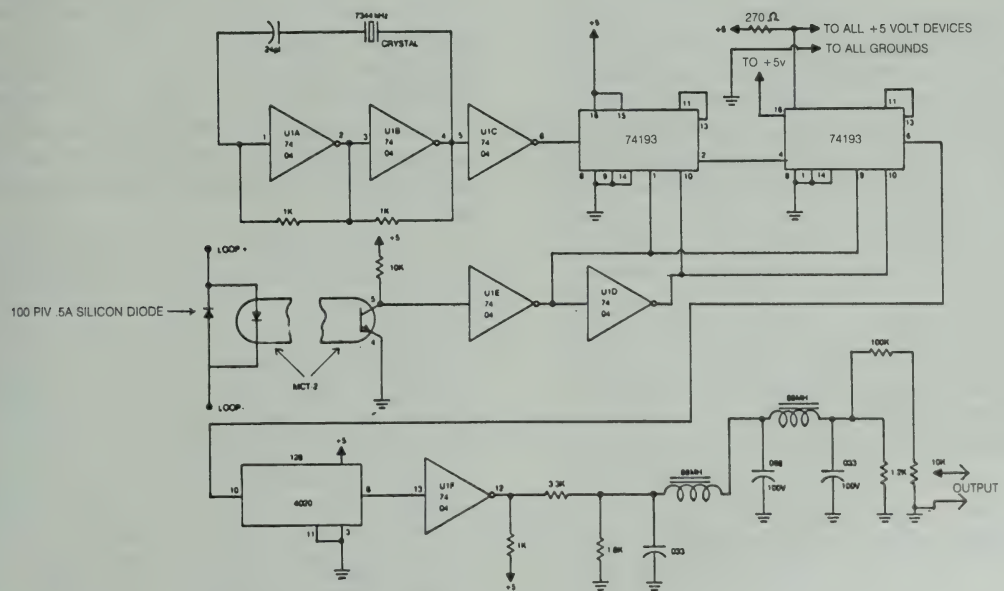


Figure 4-3 *An easily constructed AFSK generator for RTTY. Note use of ordinary-type 7344 kHz crystal for signal frequency base.*

Note: U1 A, B, C, D, E, F is a single 7404 IC. MCT-2 device is opto-isolator.

CHAPTER 5

RTTY SYSTEMS FOR HOME COMPUTERS

As you'll surely agree, RTTY interfaced home computer systems have become a widespread craze in the world of ham radio. Indeed, this area is presently a hotbed of amateur interest with future visions truly promising to expand those activities. Considering the vast popularity of home computers and their flexability in performing any number of programs - established functions, such amateur radio adaptations may be quite justified and logical. Possibly this situation is also due to the fact that although RTTY is a semi-specialized area of communications, readily available commercial units now make it possible for all amateurs to join the action. . .regardless of their technical background. The only challenging criteria here relates to one's projected level of RTTY involvement; that is, whether to use a home computer or a dedicated terminal setup for RTTY activities. We will present an impartial and (hopefully) unbiased study of these areas in both this and the following chapters for your consideration. Armed with that knowledge, you can then draw your own conclusions and select equipment or assemble your own system as you personally deem feasible and desirable.

While dedicated units accomplishing only specified operations usually afford the best overall performance, properly adapted home computer systems can offer a less expensive alternative to involvement with several specialized interests. If, for example, you either own or are planning to purchase a computer for maintaining home inventory, calculating finances, and for enjoying a few arcade-type games, adding RTTY capabilities to that system would be quite attractive. Should you later care to move into "heavy" letter writing and card mailing, only a few extra items would be necessary for computer expansion. Likewise, the station's logs and awards-program tallies could be computer-processed and filed on cassettes or floppy discs. Should you also decide to expand amateur activities to include Slow Scan TV or calculate orbital data for OSCAR satellites, the computer can again be reprogrammed and interfaced for those operations. Yes, the home computer is a very flexible unit capable of many "different faces". . .and fortunately, the retail cost of these computers is quite reasonable. We might also add that today's "computerized RTTY" barely resembles a compromising situation: the two areas mate almost perfectly.

The most popular home computers being used in conjunction with amateur radio setups at this time are the Radio Shack TRS80C, the Apple II, the Commodore VIC20 and 64, and the Atari 400/600/800/1200 series of units. Those units are thus the primary focus of the RTTY systems available commercially and reviewed in this chapter.

There are presently a number of advertising campaigns boasting how some of these home computers are the most powerful, have the largest memory, are supported by extensive software, etc. These statements may hold merit if you're involved with writing your own programs or looking for extensive software banks to support your planned computer uses, but they hold a lower significance for RTTY activities. Almost any popular computer with at least 5K of working memory (RAM) can be interfaced to work like a champ on RTTY. Again, however, we suggest contemplating both your present and future plans and buying accordingly. With the price of several home computers now dipping below 150 dollars, you can rest assured any "beginning mistakes" won't break your bank later.

As a beginning step in the home computer and RTTY game, let's assume you've purchased a typical amateur RTTY system and step through its initial setup and use. This assembly can begin by connecting the computer to its associated television display and confirming normal operation of those two units. This is also a good time to enter a simple 3 or 4 line test program and get a "feel" for the computer in operation. A sample test program is shown in **Figure 5-1.** Note that no other programs, and only the computer's BASIC language, are used during this test. Next, the computer is switched off (which full clears its working memory), the RTTY programming cartridge is inserted, and power is reapplied to the computer (as of this writing, most RTTY programming is via ROM cards or cartridges. If your setup employs cassette or disk RTTY programming, simply refer to your computer's manual and load that medium accordingly). With the RTTY program now operational but still lacking the rig-to-

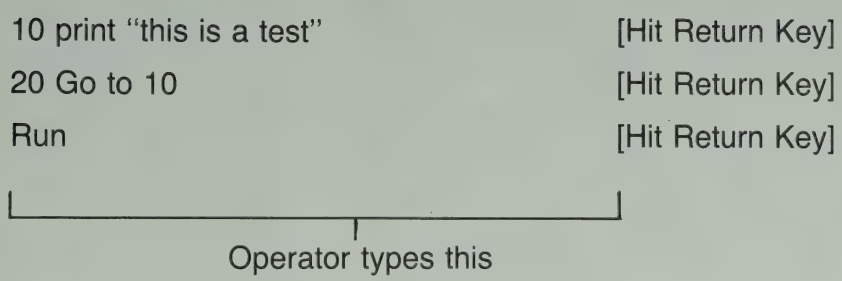


Figure 5-1 *A simple test program which can be run on any home computer featuring BASIC language. Any desired message can be inserted between quotation marks.*

computer interfacing unit, follow the software's manual to become comfortably familiar with the system. Notice how transmit/receive switching is performed, how "canned message" buffers are loaded (and possibly saved to tape for later quick power-up), how the type ahead buffer functions (if included in your program), how speeds are selected, etc. Many RTTY programs also provide audio monitoring of computer-generated signals, so remember to also check the television monitor for sound effects. Once you're comfortable with the RTTY system's programming, switch off the computer and add the RTTY interfacing unit. Most manufacturers are packaging their "RTTY interface to computer" interconnecting cable along with their software, so don't be surprised to find that vital cable in its unusual location. Simply connect the patch cable to the computer's game port input and continue. Following a few minutes time for soldering cable to mike and speaker connectors mating with one's amateur gear, the complete system is ready for checkout and use. At that point we urge you to re-read this book's chapter "Straight Talk On Home Computers" and then follow your system's instruction manuals. Enjoyable RTTY activity should then be only minutes away!

Now let's move into the second portion of this chapter and review some of the commercially available RTTY systems for use with home computers. This "what they are and how you use them" section is primarily intended to clarify RTTY system structures and use: it is not intended as endorsement or preference of one product over another. Indeed, it has also proven totally impossible to list all of the available RTTY packages, hardwares and softwares: that field is growing rapidly. . .both on local levels, on national levels and via word of mouth. It seems everyone is getting in on the action. I will add that, with few exceptions, I've personally checked and compared many of the systems which will be discussed. I then drew figures of their assembly and shot photographs (which are included). No, there are not any "favorites" to suggest. They all work grand. Again, I emphasize to both manufacturers and readers that inclusion of all available RTTY systems (and all their capabilties) is an impossibility. This book would become an encyclopedia and the publication date would approach the 21st century. We'll begin with a system you've probably seen advertised in Amateur magazines.

THE KANTRONICS INTERFACE AND HAMSOFT/HAMTEXT

One of the first and most widely known full featured RTTY system for home computers is the Kantronics "The Interface" modem and associated "Hamsoft" or "Hamtext" software. These items are available separately or as a package from Kantronics, 1202 E. 23rd Street, Law-

rence, Kansas 66044. **See Figure 5-2.** The setup can be used with any of six home computers: the TRS-80C, Apple II, VIC-20, VIC-64, TI-99 and the Atari's (400, 800, 1200, etc.). All software packages are on ROM boards, except the Apple which is on floppy disk. The system is easy to install and operate, permitting one to join the RTTY action in roughly an hour's time. An outline of the Kantronics system in use with a Commodore computer is illustrated in **Figure 5-3.** The "Interface" converts received audio tones to computer voltage levels (TTL). During transmit, the "Interface" converts the computer's output voltage levels (TTL) to tones which are directed to the station's SSB transmitter. Connections to one's existing amateur gear consists of a cable to the speaker, the key, and the microphone input. The "Interface" then connects to the computer via a specially prepared cable supplied with the software (with the traditional "Hamsoft" or the newer "Hamtext"). The computer is connected as per its manual, and the setup is ready for action.

The "Interface" itself employs an integrated circuit filter for "space" which is fixed tuned to 2295 Hz. This is the proper frequency for 170 Hz shifts. If reception of 425 or 850 Hz shift RTTY is desired, the receiver must be retuned slightly until that associated "space" frequency of 2550 or 2975 Hz is reproduced as 2295 Hz (similar to tuning SSB signals for different voice pitches). A separate active filter is not included for the "mark" frequency (2125 Hz, regardless of the utilized shift). AFSK signals generated by the "Interface" are the popular 170 Hz shift tones. The rig-interconnecting cables are furnished with the "Interface," but you must solder connectors according to pinouts of your particular rig. The Interface requires an external power source of 12 volts DC at 150 ma. (one inexpensive source of this supply is the MFJ 1312 "wall adapter unit"). A 10 segment LED tuning indicator is included on the "Interface's" front. Simply tune for the maximum number of illuminated LED's for reception. A separate CW filter is also included in the "Interface" (center frequency is 750 Hz), giving particular appeal for high speed CW buffs.

Kantronics is presently producing two software packages for the "Interface" (and similar units): Hamsoft, which is available for the Apple, Atari, TRS-80C, or the VIC-20, and the expanded Hamtext which is available

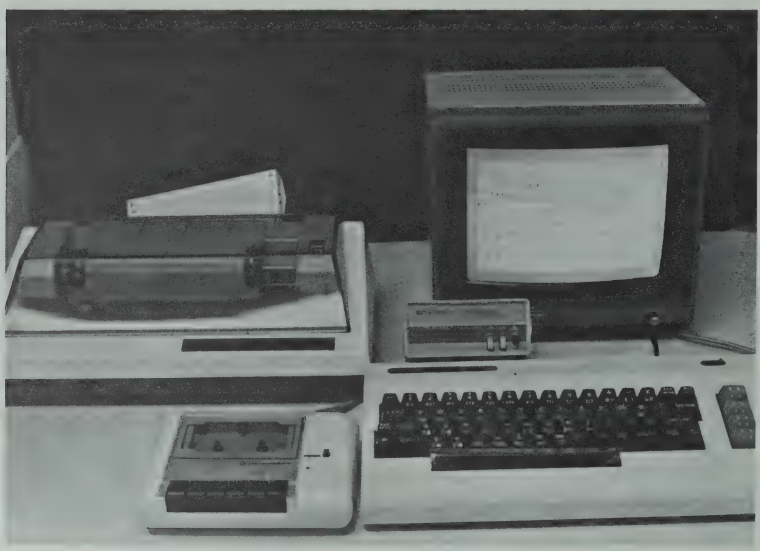


Figure 5-2 *The Kantronics "Interface" system setup and ready for use on RTTY, ASCII or CW. Items shown are Commodore VIC-20 Computer and cassette tape drive, "Interface," video monitor and optional printer. Either the Kantronics "Hamsoft" or "Hamtext" software may be used.*

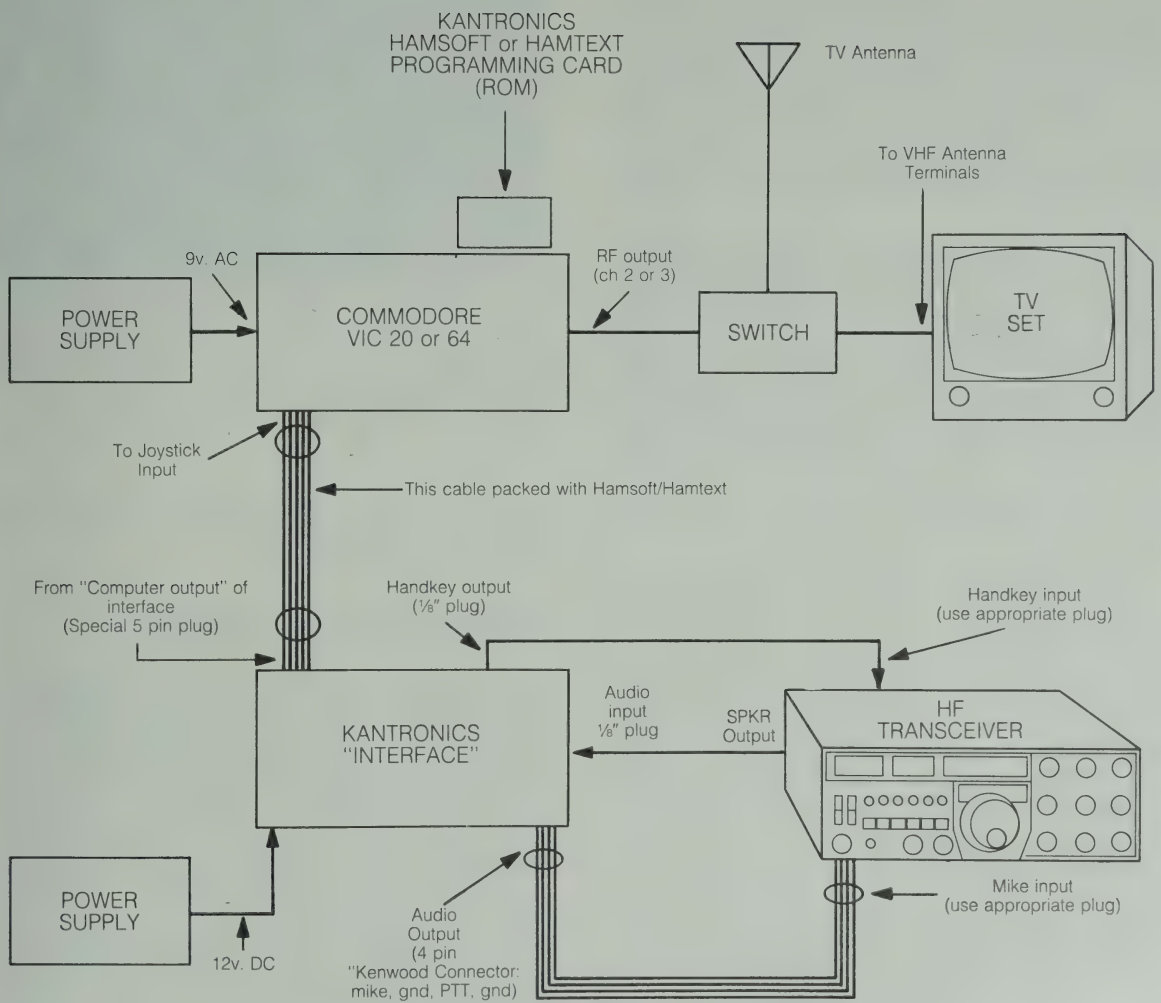


Figure 5-3 *Interconnecting structure for the Kantronics "Interface" and Hamsoft/Hamtext RTTY system. Full details are presented in text.*

for the Commodore 64 or VIC-20. **See Figure 5-4.** These software packages permit transmission and reception of RTTY, ASCII or Morse code. When connected to their related computer, a split screen display appears. Shown on that display are a (bottom area) receive section, (middle area) 1024 character-type ahead and transmit buffer, (upper line) outgoing message on a "moving display" as it is being transmitted (a single line), and (top section) printout of mode, speed, time, and transmit or receive function. Selection of speed (60, 67, 75 or 100 wpm on RTTY; 110 or 300 baud on ASCII or 5-99 wpm CW) is under keyboard control.

There are 10 programmable message buffers (each with 255 character capacity) included in the software. These "canned messages" can be used as desired (for describing station gear, operator's interest, what was recently worked on RTTY, etc.). Only 7 of the 10 canned message buffers are available on "standard" TRS-80C's with 4K or RAM. Increasing that memory to 16K permits use of all 10 buffers. CW ID is available by simply tapping the "control" and "I" keys. The Hamsoft program doesn't permit hard copy printouts on Commodore's serial data printer. A parallel-data printer must be used.

The expanded Hamtext program contains all the features of Hamsoft, plus the ability to interface with Commodore's serial printer, save canned message and holding buffer data on cassette (a true boon for initial power-ups), plus an optional "diddle" mode, automatic carriage return and line feed (lest we forget the older equipment buffs), word wraparound at line ends, and an addressable from BASIC program (which permits running non-RTTY programs without removing the Hamtext cartridge). This is accomplished by typing "SYS32768" to initialize the Hamtext program as desired. Likewise, typing "NEW" erases the program while again typing "SYS32768" reinitiates the program. All aspects considered the Kantronics software packages are quite impressive and very complete in their capabilites.

On-the-air checks of the Kantronics "Interface" and either Hamtext or Hamsoft proved to be quite enjoyable. While the "Interface" itself is a "Plain Jane" unit, it does very good on copying signals that are not buried under QRM and QRN. The use of a single filter for "space" rather than separate "mark" and "space" filters presents some minor (QRM) disadvantages, but the "direct tune compatibility" for various shifts, that is; adjusting the receiver to always produce a 2295 Hz tone for "space," is a reasonable trade-off. The Kantronics system is a good performer at a fair price.

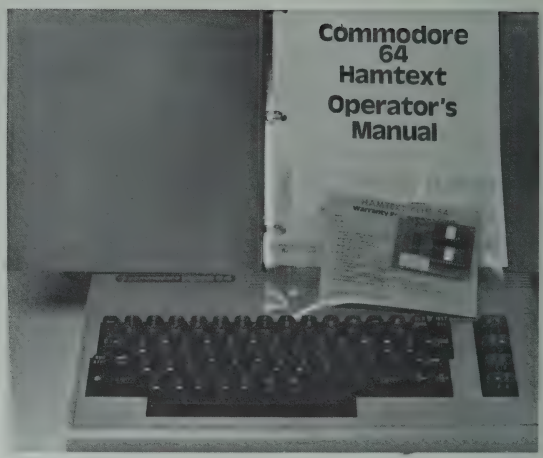


Figure 5-4 *The Kantronics "Hamtext" software package for the Commodore 64 home computer consists of a programming ROM card and a comprehensive operating manual. ROM card plugs into computer's game port.*

THE AEA CP-1 AND AEASOFT

The recently introduced AEA Computer Patch and supporting AEAsoft software is a very attractive full featured system which should appeal to both newcomers and seasoned RTTY enthusiasts. Manufactured by Advanced Electronic Applications, Inc. of P.O. Box C-2160, Lynnwood, Washington 98036, the CP-1 interfacing unit's performance is absolutely superb. Mating and similar "no compromise" software is also available from AEA for the Commodore 64, VIC-20, the Apple II, Heath H89, Atari 400/800/1200 series, the TRS-80C, and the IBM Personal Computer (optional RS-232 adapter required for mating CP-1 and IBM-PC).

In addition to an automatic threshold correction circuit, the CP-1 includes multiple stage active filters for mark and space frequencies both before and after the limiter circuit. The result of these designs is an interfacing unit that can copy signals which are quite weak or affected by mild amounts of QRM. As with other "computerized RTTY" setups, the AEA system can be assembled and readied for use on RTTY, ASCII or CW within roughly an

Figure 5-5 *The AEA CP-1 system ready for use on RTTY, ASCII or CW. Items shown include CP-1, VIC-20 Computer, Cassette tape drive and tape RTTY program plus system operating manual.*

hour's time **(See Figure 5-5).** An interconnecting outline of the AEA RTTY system is shown in **Figure 5-6.** The CP-1 is connected to the speaker, key and microphone jacks of a transmitter and receiver or transceiver via short cables (solder plugs according to your rig's instruction manual-illustrated pinouts). Next, connect the specific computer's software-supplied cable between the CP-1 and the computer's external input port, and load the associated software (we will assume the computer system and display were previously set up, checked, and operating correctly). The system should then be ready for action.

The CP-1 proper features front panel selection of either the fixed-tuned 2295 Hz space filter or a 2225 to 3125 Hz tunable filter (the mark filter, you'll recall from RTTY theory, must stay preset to 2125 Hz). This capability permits copying any RTTY shift from 100 to 1000 Hz. Other front panel controls include an automatic or manual transmit/receive switch, normal or reversed tone selection, plus an LED bar graph tuning indicator. The rear panel-

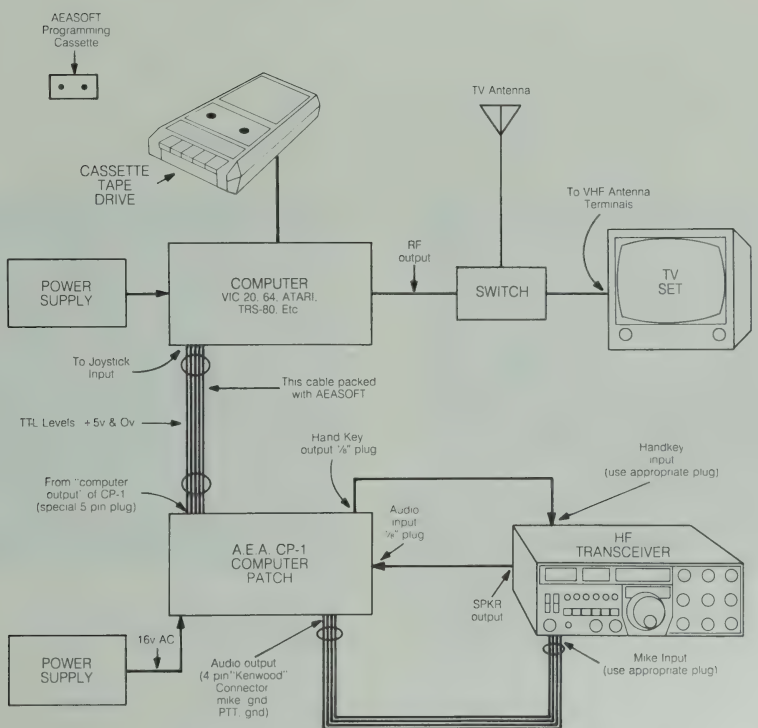


Figure 5-6 *Assembly layout for the AEA system, illustrating cabling and wiring of interconnected items.*

adjustable automatic threshold circuit functions like an "RTTY squelch" in determining the specific weak signal point where unintelligible "garbage" is printed on the monitor screen. Also included on the rear apron are scope X and Y outputs for RTTY "crosshair displays," positive and negative keying outputs, two speaker connectors (for "normalling through" to an external speaker, if desired) a hand key input (for Morse ID's during RTTY operations) and a 5 pin "TTL output" for the computer. A 4 pin mike connector is used for directing output AFSK tones to an SSB transceiver. Finally, a separate 950 Hz CW filter is included in the CP-1 for high speed CW buffs. **(See Figure 5-7, 5-8 & 5-9).**

The CP-1 is powered by a 16 volt AC "wall adapter". . .a somewhat unusual voltage, but this item is also supplied with the CP-1. Neither the CP-1 or its "wall adapter" produced noticeable heat during periods of extended operation (or when forgetting to unplug the "wall adapter" when switching off the CP-1!).

Figure 5-8 *Rear view of the AEA CP-1, showing connectors and their use. RS232 socket is optional while TTL jack is standard (mating connector is supplied with specific computer software package). Note RTTY threshold adjustment.*

Figure 5-7 *Front panel view of the AEA CP-1 reveals neat and functional layout complete with tuning indicator.*

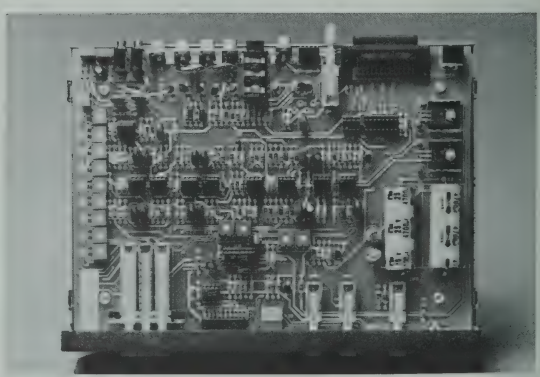


Figure 5-9 *Interior view of the CP-1 indicates a clean, neat and efficient layout.*

As this book is being written, AEA is producing two forms of software for several home computers. One, a less expensive cassette package for the VIC-20, is an RTTY introductory program with 3 message buffers and separate screen displays for transmit and receive. The other package(s) are full-blown RTTY/ASCII/Morse programs on either ROM card or floppy disk for their related computer. Both packages operate RTTY at 60, 67, 75 and 100 wpm. The "full featured package" includes split screen displays, 10 "canned" message buffers, UnShift On Space, Carriage Return and Line Feed, printer compatibility, etc. If you're a "serious RTTY enthusiast," the "full featured AEAsoft" is your best choice. It's also interesting to note that AEA and Kantronics software are interchangeable. If your dealer doesn't have one, try the other!

Our on-the-air checks of th AEA system might be best summarized as "superb." The system performed as expected, copying unusual shifts and weak signals quite admirably. The Automatic Threshold worked great for eliminating on-screen "babbling" during periods of non-RTTY reception.

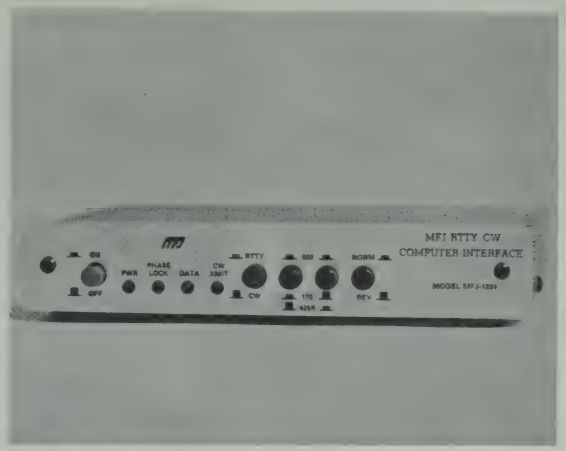


Figure 5-10 *The MFJ 1224 Computer interface unit can be used with a variety of computers and software packages, or one can write his own RTTY program.*

THE MFJ 1224 COMPUTER INTERFACE

There are occasions when a radio amateur may invest his allocated finances in a full home computer system, leaving low funds for an RTTY setup, likewise, many amateurs would like an inexpensive approach to "computerized RTTY" which could be later expanded according to needs and knowledge gained during that early "learning period." Bearing those thoughts in mind, MFJ Enterprises, Inc. of Box 494, Mississippi State, Mississippi 39762, developed their model 1224 computer interface unit for use with a variety of computers and software packages.

The MFJ 1224 is an inexpensive yet high performance RTTY/ASCII/CW modem which converts incoming tones to computer level pulses during receive, and computer pulses to AFSK signals during transmit. A number of accurately-marked rear panel connectors are provided for interfacing with many home computers, and the unit is designed to work with a number of software packages. The "end results" provide an easily affordable route to RTTY. . .especially if one has access to (or writes) his own RTTY program.

The 1224 computer interface unit features front panel selection of 170, 425 or 850 Hz shifts, plus normal or reverse tone demodulation. **(See Figure 5-10).** The unit copies both mark and space signals, reverting to either of those tones if the other becomes "QRMed." An 8 pole active filter is used for mark tones, and an automatic noise limiter is included to reduce static disturbances. Dual LED's are used for tuning indication; one indicating phase lock on mark and the other flickering with space signals. The unit's AFSK generator uses an Exar 2206 function generator IC, and can be set for either 170 Hz shifts (2125/2295) or 850 Hz shifts (2125/2975). An FSK output is also provided for "deluxe" transceivers with rear panel FSK connections. The 1224's rear connections include speaker in and out (for "normalling through"), teleprinter loop (for keying your 20/60 ma. supply), RTTY demodulator output (TTL level), a Kantronics-campatible connector (for use with Kantronics software and computer cables), a "general" output connector with each pin marked (for use with RAK or user designed RTTY software setups/interconnects), a marked "mike output" connector (for patching tones to an SSB transceiver), direct and grid block keying outputs, hand key input , and a 12v DC input connector. This unit can, obviously, be used with a wide variety of home computers, software arrangements and amateur radio gear.

An illustration of the MFJ 1224 computer interface in operation in exemplified in **(Figures 5-11).** The 1224 is connected to the key, speaker and microphone inputs of one's HF transceiver. Connectors are supplied for mating with plugs on the MFJ unit, but you may need to secure your own mike plug. Likewise, a "computer output" plug is supplied for those rigging their own software and computer cables. Some of the popularly available software

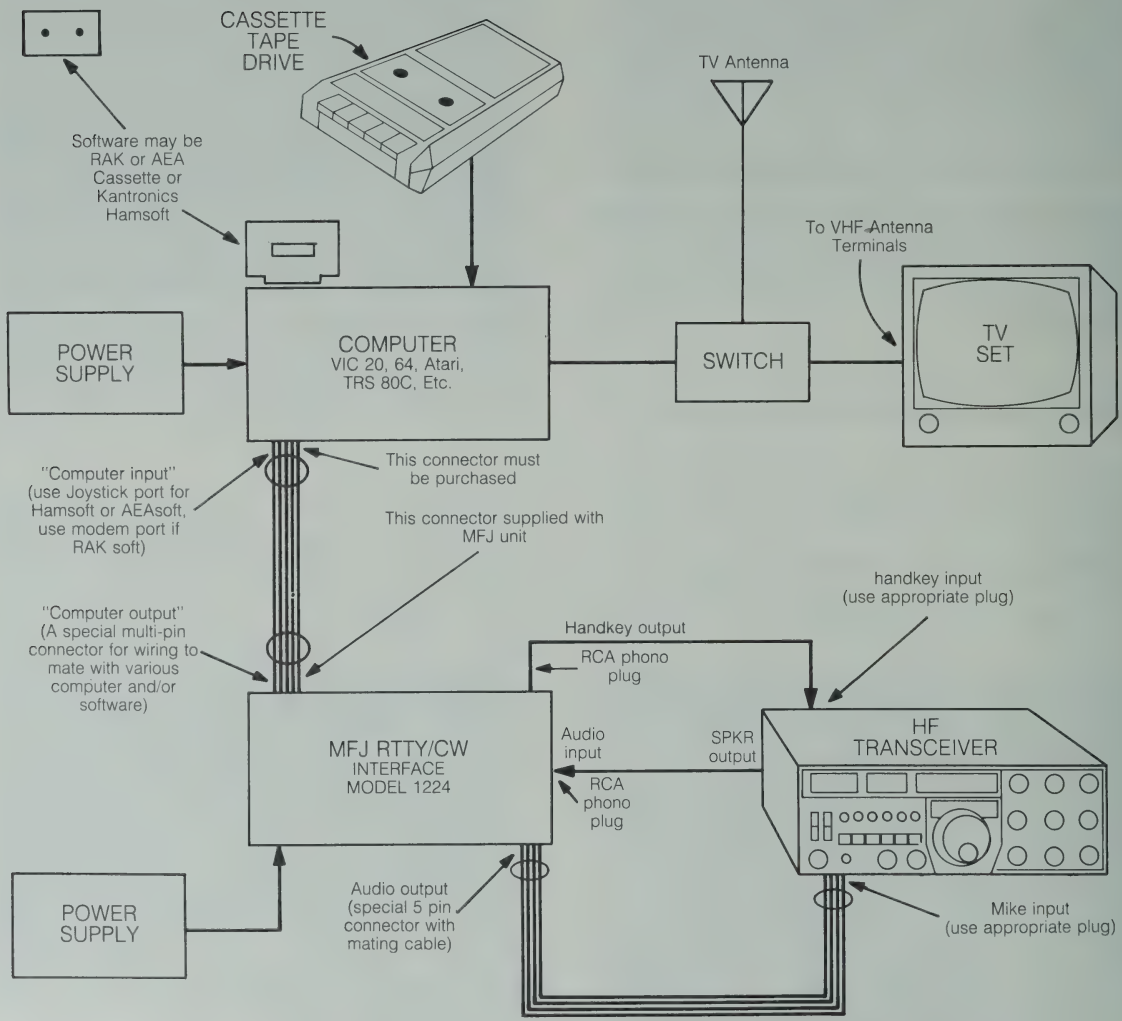


Figure 5-11 *General outline for an inexpensive RTTY/ASCII/CW system using the MFJ 1224 interface and RAK or AEA software.*

which can be used directly with the MFJ 1224 interface are the AEA and Kantronics. The Galfo software can be used with Apple computers and RAK with Commodore computers, but you'll need to wire the interface-to-computer cable (a simple, 15 minute project).

The MFJ 1224 computer interface is a smooth performing unit capable of very good results. Its adaptability to inclusion in a variety of "custom assembled" systems is also complimented by its reasonable cost. The 1224 copies all shifts of RTTY and ASCII, plus CW, RTTY, ASCII and CW speeds, you'll recall from previous theory, are functions controlled by software.

THE RAK SOFTWARE PACKAGE

A number of radio amateurs prefer home constructing their own RTTY interfacing unit for use with an HF rig and computer, but they don't have the time, ability or interest to write their own software. Enter the RAK Electronics VIC RTTY package: a cassette program for the Commodore VIC-20 featuring split screen display, type ahead buffer, programmable CQ and ID, real time clock and operation at 60, 67, 75 and 100 words per minute. Also included in the RAK package is an eleven page software manual, an eight page hardware manual containing wiring suggestions/pinouts and schematics/construction details on a homebrew interfacing unit and a connector for mating one's interface to the VIC-20 computer. The package was designed by Russell Grokett, Jr., WA4EFH of Kinetic Designs, 401 Monument Road #171, Jacksonville, Florida 32211, and it provides an inexpensive but effective way to join the action of RTTY today. **(See Figure 5-12).**

The RTTY terminal described in the hardware manual uses an Exar XR 2211 AFSK demodulator IC for RTTY reception and an Exar XR 2206 function generator IC for generating AFSK tones for transmission. The circuits are basic and simple in design and should thus present few problems to the home constructor, regardless of his technical background (if you have an amateur radio license, know how to solder, follow a schematic, and perform a little audio-range troubleshooting, you're "home free"). The components for this RTTY interface are available from Jameco Electronics, 1355 Shoreway Road, Belmont, California 94002. Write for their latest catalog of RTTY parts and items.

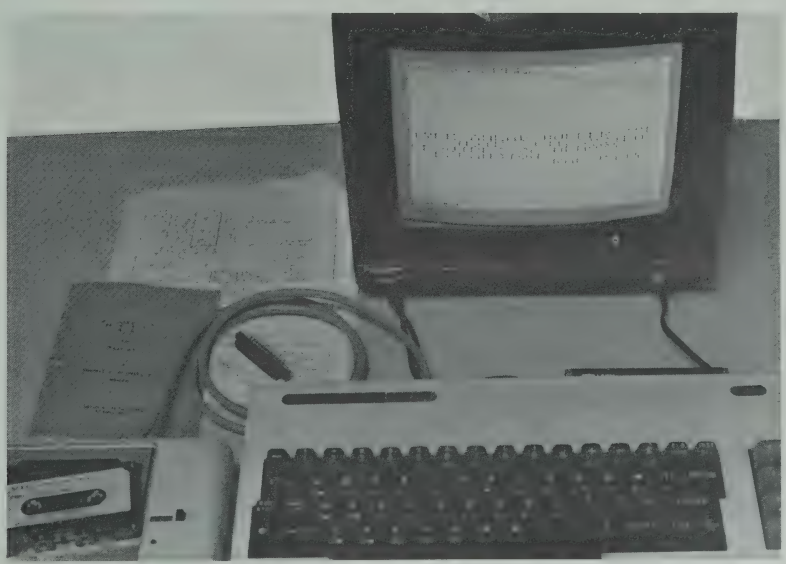


Figure 5-12 *The RAK software package includes a hardware manual describing an easily constructed demodulator and AFSK unit. System requires at least 9K memory expansion to VIC 20.*

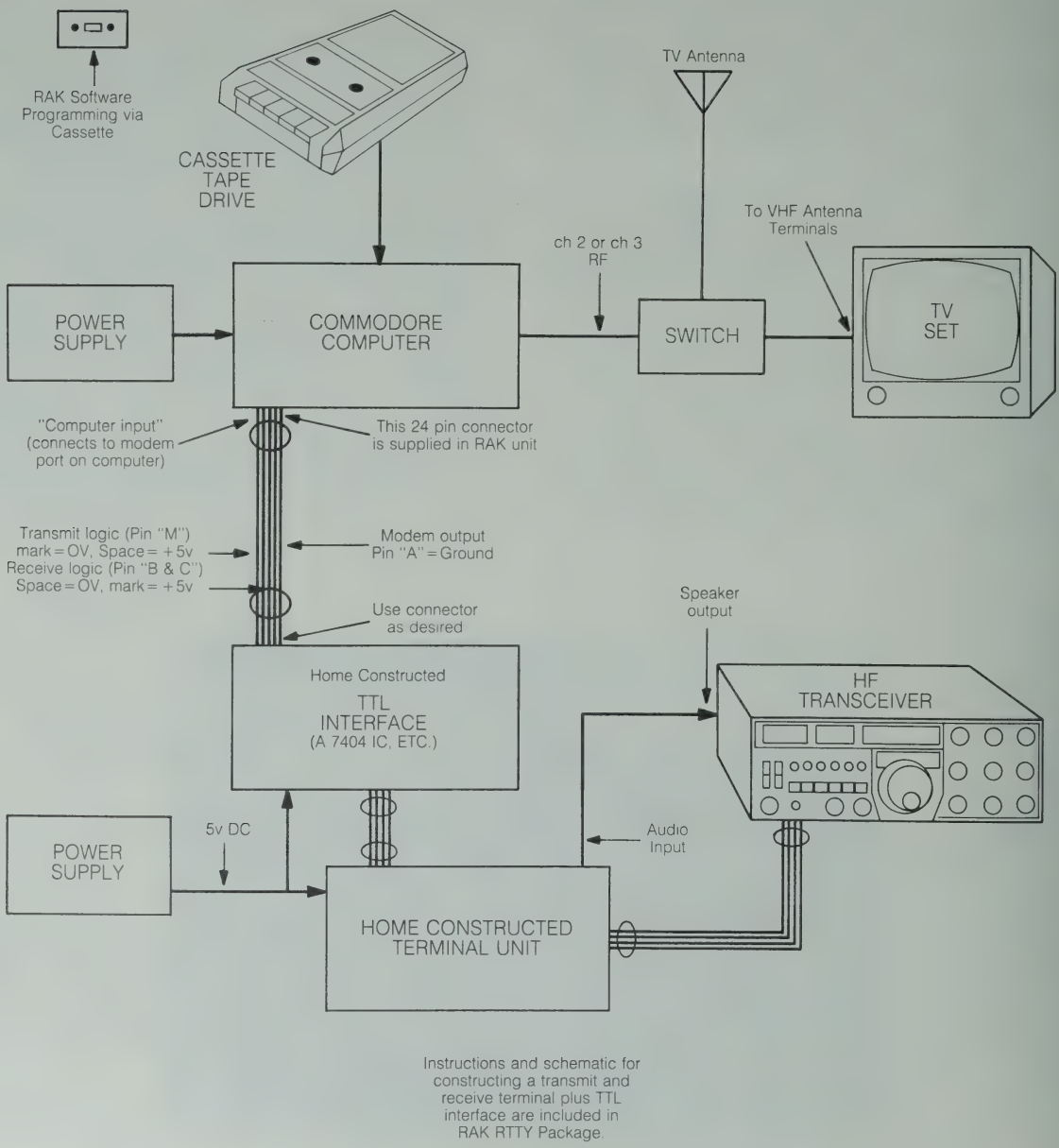

RAK Software Programming via Cassette
CASSETTE TAPE DRIVE
TV Antenna
To VHF Antenna Terminals
ch 2 or ch 3 RF
POWER SUPPLY
COMMODORE COMPUTER
SWITCH
TV SET
"Computer input" (connects to modem port on computer)
This 24 pin connector is supplied in RAK unit
Transmit logic (Pin "M") mark = OV, Space = +5v
Receive logic (Pin "B & C") Space = OV, mark = +5v
Modem output Pin "A" = Ground
Use connector as desired
Speaker output
Home Constructed TTL INTERFACE (A 7404 IC, ETC.)
HF TRANSCEIVER
5v DC
Audio Input
POWER SUPPLY
HOME CONSTRUCTED TERMINAL UNIT
Instructions and schematic for constructing a transmit and receive terminal plus TTL interface are included in RAK RTTY Package.

Figure 5-13 *General outline of a home-constructed interface and RAK software system for RTTY. This highly flexable arrangement is discussed in text.*

The RAK program can be used with the MFJ 1224 interface, but one must wire his own interface-to-computer patch cable (remember, this is essentially an RTTY program for use by home construction enthusiasts).

The general layout of a typical home constructed RTTY-only system using the RAK Electronics software is shown in **(Figure 5-13).** The homebrewed terminal is connected to the speaker output and mike input jacks of an HF transceiver. If the previously discussed RAK terminal is used, a TTL interface employing a 7404 (or similar) IC circuit is then assembled and used for providing proper TTL-level compatibility between the interface and computer. The RAK program uses the Commodore's modem port for interconnections, and that multipin edge connector is supplied with the package. Following assembly, checkout and alignment of the terminal unit (and assembly of the proper interconnecting cables), the cassette RAK VIC RTTY program is loaded and the systems is ready for use. At this time, RAK Electronics is producing RTTY programs for only the Commodore VIC-20 home computer. Considering the large number of RAK programs available for other amateur radio applications (Morse Communications, DXCC listings, WAC, mailing labels, etc.) RAK may soon produce RTTY programs for other home computers.

THE MICROLOG AIR-1 PACKAGE UNIT

Amateurs desiring an "everything in one piece" RTTY/ASCII/CW setup will surely appreciate the design of Microlog's AIR-1 system. Manufactured by Microlog Corporation of 18713 Mooney Drive, Gathiersburg, Maryland, this combination software and hardware board is designed to directly plug into the expansion port of a Commodore VIC-20 home computer. **(See Figure 5-14).** The resultant "stand alone" arrangement is quite flexible and boasts a number of very attractive features.

The AIR-1 is completely powered by the VIC-20 computer, making initial setup a snap. **(See Figure 5-15).** Audio signals to and from the AIR-1 are connected to the station's HF transceiver via appropriately mating plugs, and you're ready for action. Assuming the VIC-20 has previously been set up and operating with a television monitor, merely unplug any unnecessary peripherals (tv games, joysticks, etc.) and insert the AIR-1 cartridge.

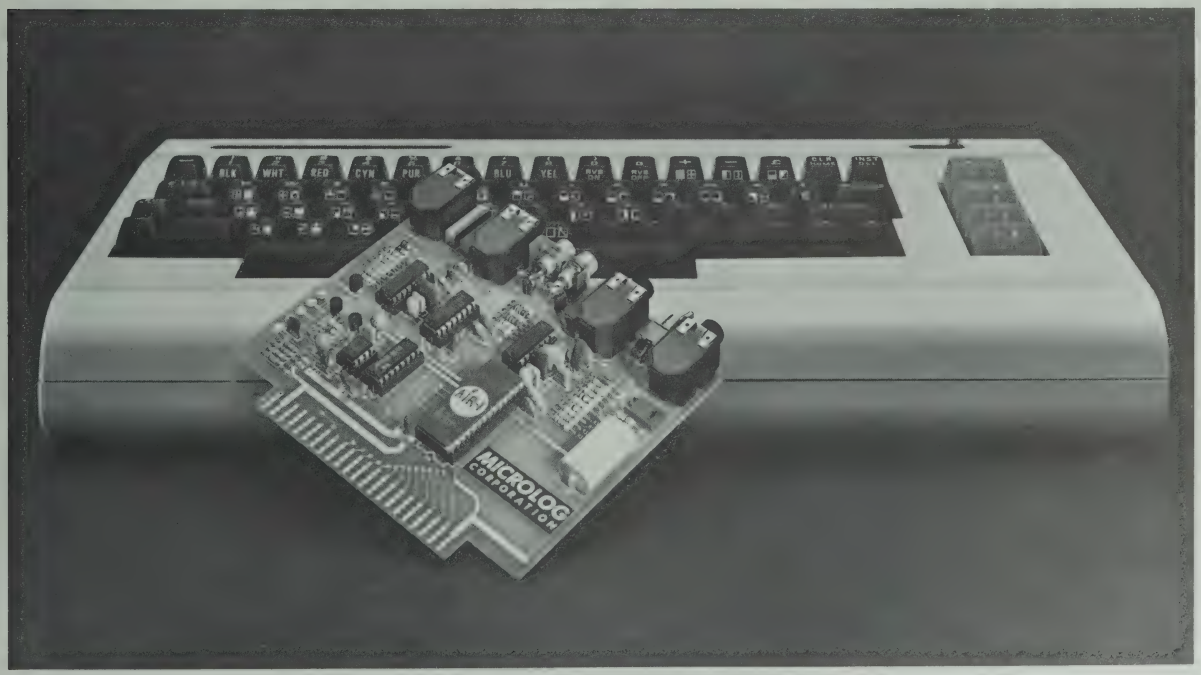


Figure 5-14 *The Microlog AIR-1 unit contains both RTTY/ASCII/CW software and hardware on a single printed circuit board which directly plugs into the rear game port of a VIC 20 Computer.*

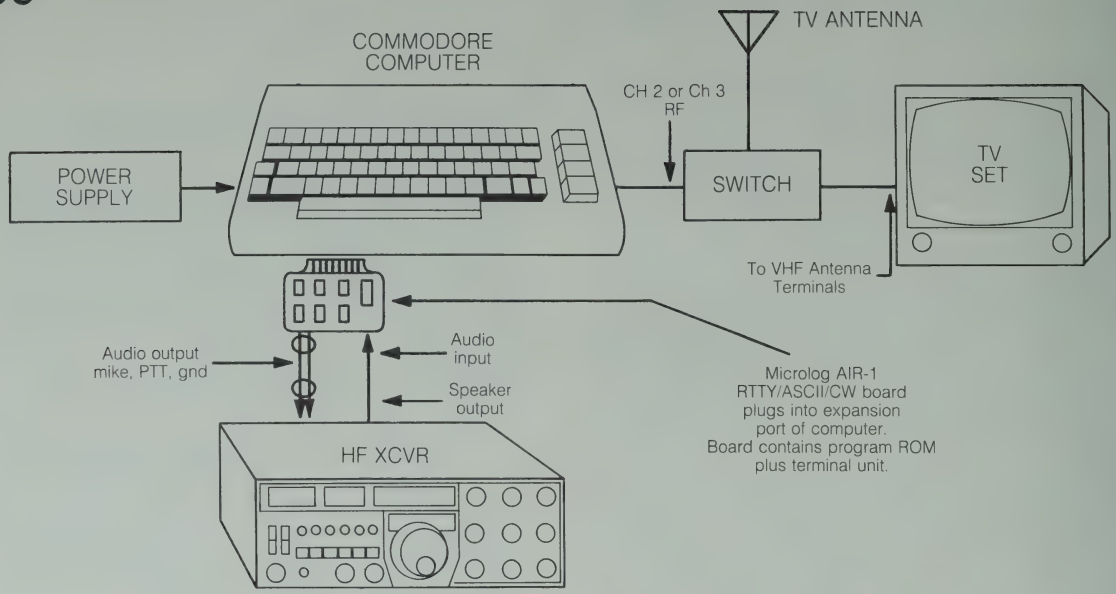


Figure 5-15 *Interconnecting outline of an RTTY/ASCII/CW setup using the Microlog AIR-1 system and a Commodore Computer.*

What could be easier or more troublefree. When switched on, the RTTY-ready computer will operate RTTY with either 170 or 850 Hz shifts and 60, 67, 75, 100 or 132 words per minute speed, ASCII of 110 or 300 baud, and CW of 5 to 199 wpm. The AIR-1 is directly compatible with the standard VIC printer for hard copy, and with the VIC cassette or disc drive for storing received, "canned" or transmit buffer messages. There are also "quick brown fox" and RY test messages plus two independent 16 character ID memories built into the system. If all that isn't enough, the AIR-1 includes WRU (who are you): automatic response to a user-programmable 15 character sequence and SELCAL: an unattended electronic message storage which uses one user programmable code for activating the printer, tape or disk drive and another code for deactivating those items. An amateur using this setup could thus specify a code for a distant friend, and receive a message at a later time.

A sketch of the AIR-1 board's rear connections and controls is shown in **(Figure 5-16).** In addition to a local loop output for older teleprinters, a positive or negative CW keying output, transmitter AFSK and PTT connections and a hand key input, the board also provides FSK output, switch selection of wide or narrow shift and speaker "normal through" capability. Circuitwise, the AIR-1 uses true dual tone demodulation with a very effective circuit design. The board is G-10 epoxy, double sided with plated through holes. It may plug directly into the VIC-20 or may be used with an expansion Motherboard should additional working memory (RAM) be desired.

The AIR-1 software allows the user to specify size of the text buffer and eight canned messages from the computer's working memory, and memory expansion cartridges can be used! Upon power of an unexpanded VIC-20 (5K memory; approximately 3000 characters) the eight canned messages will each hold 10 characters and the text buffer will hold approximately 2200 characters. One example of how these allocations may be changed is eight 300 character buffers and a 600 character text buffer.

Also featured in the software is split screen transmit/receive information display (with top line readout of mode, speed, time and transmit/received status), an on-screen tuning indicator (plus an audio-monitor signal), USOS, RTTY fill during blank periods, word wraparound and output via character, via word or via line to the transmitter. As of this writing, the Microlog AIR-1 is available only for the economical Commodore VIC-20 computer. Hopefully, additional AIR-1 units will soon be available for other popular home computers.

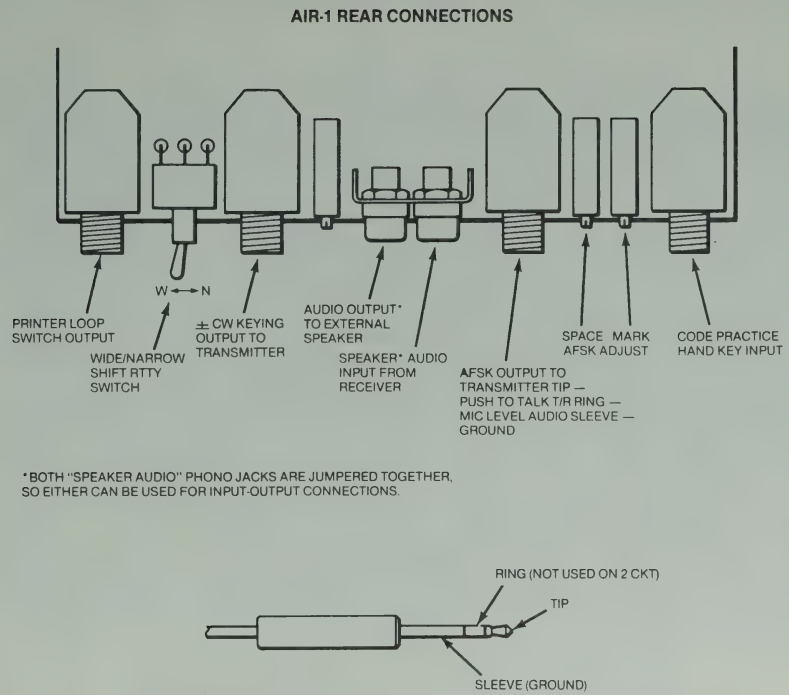

AIR-1 REAR CONNECTIONS
W ⟷ N
PRINTER LOOP SWITCH OUTPUT
WIDE/NARROW SHIFT RTTY SWITCH
± CW KEYING OUTPUT TO TRANSMITTER
AUDIO OUTPUT* TO EXTERNAL SPEAKER
SPEAKER* AUDIO INPUT FROM RECEIVER
AFSK OUTPUT TO TRANSMITTER TIP — PUSH TO TALK T/R RING — MIC LEVEL AUDIO SLEEVE — GROUND
SPACE AFSK ADJUST
MARK ADJUST
CODE PRACTICE HAND KEY INPUT
*BOTH "SPEAKER AUDIO" PHONO JACKS ARE JUMPERED TOGETHER, SO EITHER CAN BE USED FOR INPUT-OUTPUT CONNECTIONS.
RING (NOT USED ON 2 CKT)
TIP
SLEEVE (GROUND)

Figure 5-16 *Rear connections on the AIR-1 board illustrating layout of connections and controls.*

THE MACROTRONICS TERMINAL SYSTEM

A very deluxe and truly full featured RTTY/ASCII/CW setup for home computers is the Terminal System manufactured by Macrotronics, Inc. of 1125 North Golden State Blvd., Suite G, Turlock, California 95380. **(See Figure 5-17).** Designated as the Terminal T1 and T3 for TRS-80 models 1 and 3, the T2 for the Apple II and Apple II Plus, and the T4 for the Atari 400, 800 and 1200 computers, each package contains a high performance transceiver to computer interfacing unit plus extensive software and all interconnecting cables. There's also prewired cables for key and speaker connections (solder mike connector according to your rig) plus an extremely well documented operating manual and a desktop quick reference card. **(See Figure 5-18).** A full description of the Terminal System would encompass more pages than this complete chapter (their complete manual is over 100 pages long), thus we'll merely highlight some of the most commonly queried areas.

First off, the Terminal System isn't overly complex unless specifically desired. It can be quickly rigged and operated simply. As other features and capabilities are desired, simply refer to the manual: the System is ready for those expanded applications. The System is capable of making full use of its associated computer's functions and could thus be considered a home computer buff's dream.

The basic layout of a Terminal System is exemplified in **(Figure 5-19).** The interfacing unit connects between one's SSB transceiver and home computer with supplied cables. If the exemplified Atari computer is used, connections are via game ports 1 and 2. The software for this system is then loaded via cassette or disk, and it's ready for action. Notice there are two possible connection ports shown for the printer. This flexibility is quite attractive, since Atari's cassette drive is their only peripheral lacking a "normal through" connection for additional daisy chained items.

The terminal unit itself is capable of both transmit and receive operation with 170, 425 or 850 Hz shifts. Keyboard selection of the proper space filter is accomplished by electronic switching in the unit. Multiple filters for both mark and space are utilized, with their outputs going to a wired-OR for signal processing under poor conditions. The filter's outputs are also ANDed and directed to a meter amplifier for tuning indications. The CW portion of this unit includes several active bandpass filters, a CW threshold adjustment and a pulse/no pulse processing section. There's teleprinter loop input/output connections and an RS232 port also featured. The unit is fully shielded; even the side panels are sprayed with a

Figure 5-17 *The Macrotronics Terminal system provides full featured RTTY/ASCII/CW operations in an effective and well organized manner. Simply add rig, computer and video monitor for enjoyable operations.*

Figure 5-18 *The full Terminal package, containing Transceiver to Computer interface unit, interconnecting cables, software, highly detailed operating manual, plus desktop reference cards.*

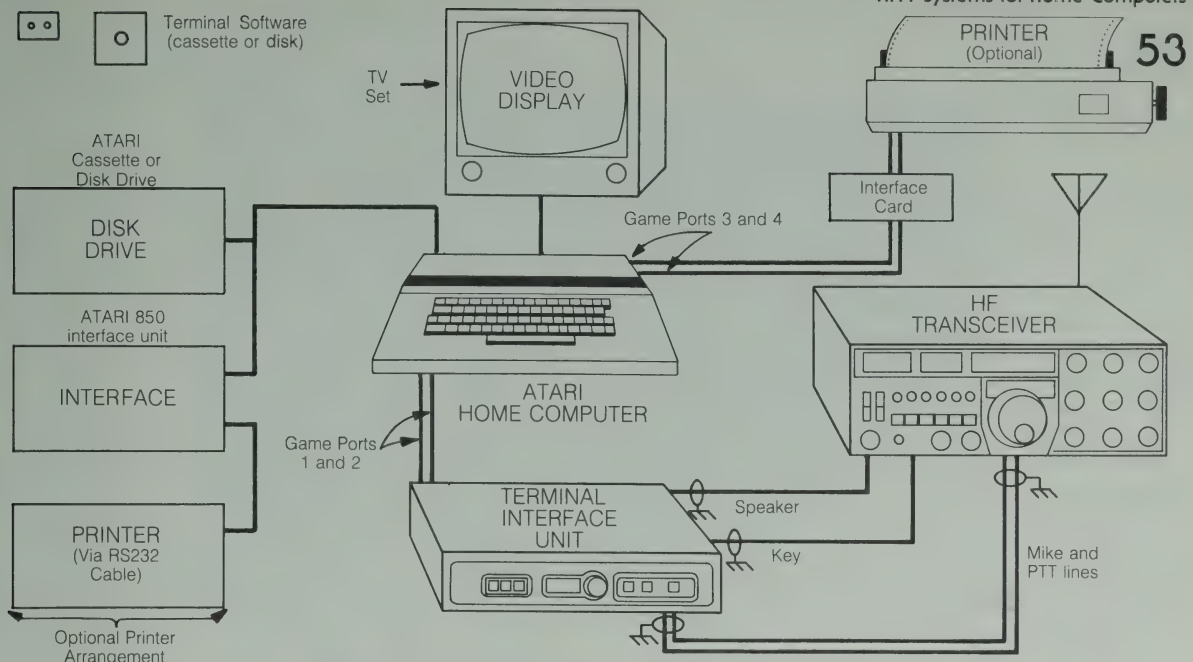


Figure 5-19 *Basic layout of the Terminal system, illustrating interconnection of elements. Note two methods of printer connection are possible: one using Atari interface and the other using Terminal interface.*

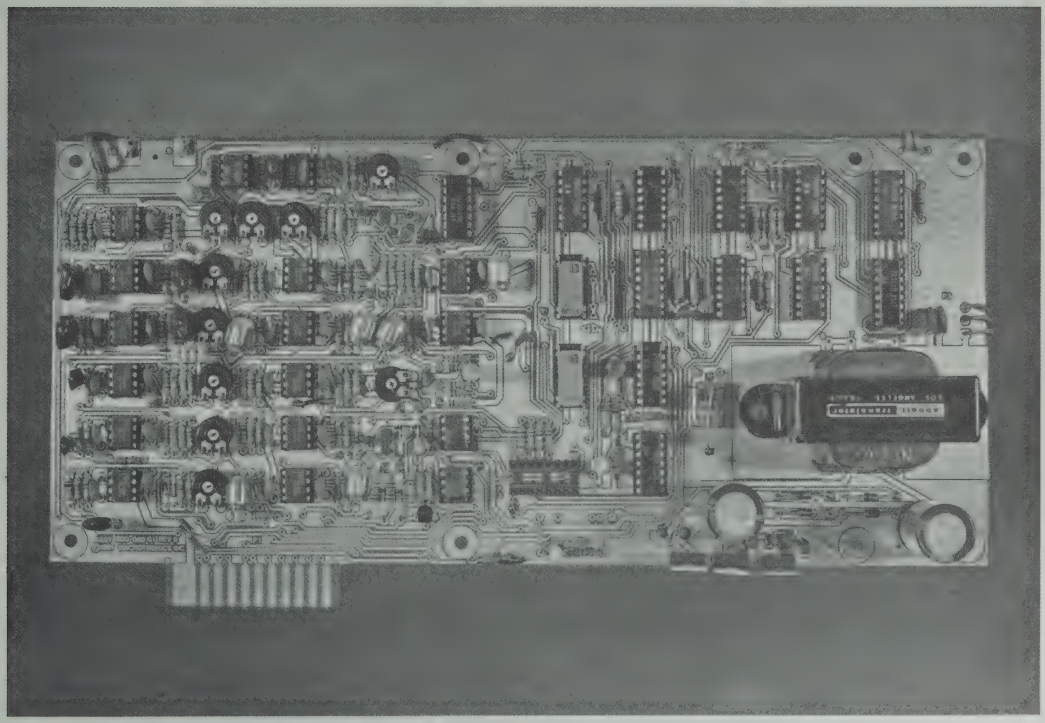


Figure 5-20 *The main circuit board used for the Terminal unit reveals professional planning and component layout.*

special RF1 shielding material. Operation may be via 110 or 220 VAC, and a 60 Hz sampling internal clock is employed **(See Figure 5-20).**

As previously mentioned, the software portion of this system is very complete. There are 16 canned message ports available, and soft sectoring permits storing a message any length up to the computer's available memory. There's a large type ahead buffer, with selection of transmit methods (via letter, word, line, paragraph, etc.) If you're not a sharp typist, the system will even insert variable time delays according to the type ahead buffer's contents to give a more professional appearance to transmissions. Also featured are RTTY autostart, WRU and "WRU answerback" for unattended message type operations. One unique feature of the system is its review window for looking back on past information. Resembling an electronic counterpart to older teleprinters, the operator can scroll through "pages of past type" as desired. . . and even mark desired information and print out the selected section.

The system's normal form of operation includes split screen with a single line of "being transmitted" information, a portion of the review window and readouts of mode, shifts, speed, real time, etc. The "usuals" of USOS, auto CR/LF, etc. are also included and either "normal " or "reverse" tone polarity is software-selectable. Extensive use of the computer's capabilites and functions allow this system to perform almost any imaginable function.

THE BLINKY RTTY TUNING INDICATOR

The ability to properly tune an RTTY signal by "feel and sound" is a time-acquired trait which may prove difficult to master. Consequently, most RTTY enthusiasts rely on some form of mark/space tuning indicator. One of the oldest and most well known of these indicators is the crosshair oscilliscope display which shows mark and space filter outputs on horizontal and vertical axis. Recent commercially manufactured gear includes some type of tuning indicator. . .an LED bar graph, dual LED's, an analog meter, etc., but an external audio frequency meter is still highly desirable for RTTY tuning. This situation is particularly true for RTTY newcomers desiring minimum "fumbles" and maximum copyable reception.

As we all know, there are three possible variables associated with RTTY today: mark/space shifts (170, 425 and 850 Hz), normal or reversed mark/space tone polarity, and speeds of 60, 67, 75 and 100 words per minute. Reducing these variables to the most successful-copy odds can thus be a blessing.

One of the more attractive solutions to the RTTY tuning dilemma is the "Blinky" manufactured (completely assembled and tested) by Timekit, P.O. Box 22277, Cleveland, Ohio 44122. Housed in a black plastic cabinet with a grey front, the unit measures only 2 by 3 by 5½ inches (H, W, D). The front panel hosts a number of LED's mounted behind a semi frosted-red colored readout area on which frequency calibrations between 1200 and 2300 Hz are marked. **(See Figure 5-21).** Inside, the Blinky consists of an amplifier/limiter stage which drives six temperature stabilized and sharply tuned active filters. This arrangement and the response of each filter/LED circuit is shown in **(Figure 5-22 and 5-23).** Each filter's output causes its LED driver to enable its respective LED, thus accurately indicating received tones and their shifts. The Blinky can be powered by any conventional 9 to 12 VDC source, such as a popular "wall adapter." Connection to one's RTTY setup is simply a matter of paralleling speaker output (many RTTY interfacing units include "normal through" connections which are often unused, and are thus ideal for quick Blinky hookups). Both DC and audio inputs on the Blinky's rear employ regular ⅛ inch barrel plugs.

The Blinky adds a new ease of tuning to RTTY setups, providing simple and enjoyable operations. If blinking LED's appear on 1500 and 1900 Hz, for example, a mistuned 425 Hz shift RTTY signal is indicated. Setting the terminal unit accordingly and retuning until the 1500 Hz tone is displayed at 2100 Hz (while the 1900 Hz tone is run off the scale's upper end) puts things "right in place" for smooth copy. What could be easier! Once accustomed to viewing the Blinky's display, reverse-polarity signals can be spotted by noting which LED flickers most. This compact and versatile item is a worthwhile addition to almost any RTTY system.

THE AEA AMT-1 AMTOR TERMINAL

Leading the move toward interest in AMTOR communication, Advanced Electronic Applications, Inc. of P.O. Box C2160, Lynnwood, Washington 98036, recently introduced their model AMT-1 terminal unit. **(See Figure 5-24).** A detailed discussion of AMTOR concepts was presented in the chapter "Straight Talk On Home Computers" thus we will assume you are familiar with AMTOR parameters during the following discussion.

The AMT-1 is designed to operate ARQ, ARQ listen

Figure 5-21 *The Timekit Blinky is a very effective and easy to use tuning aid for RTTY which can be used with any setup. Audio frequencies are read directly on front panel display.*

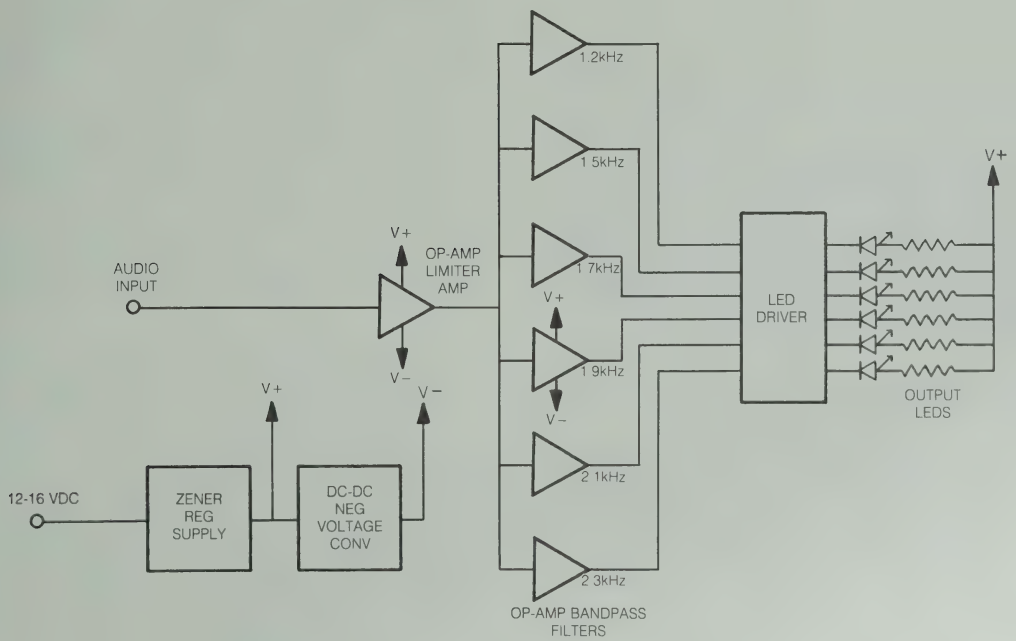


Figure 5-22 *Blinky Model 959 Block Diagram*

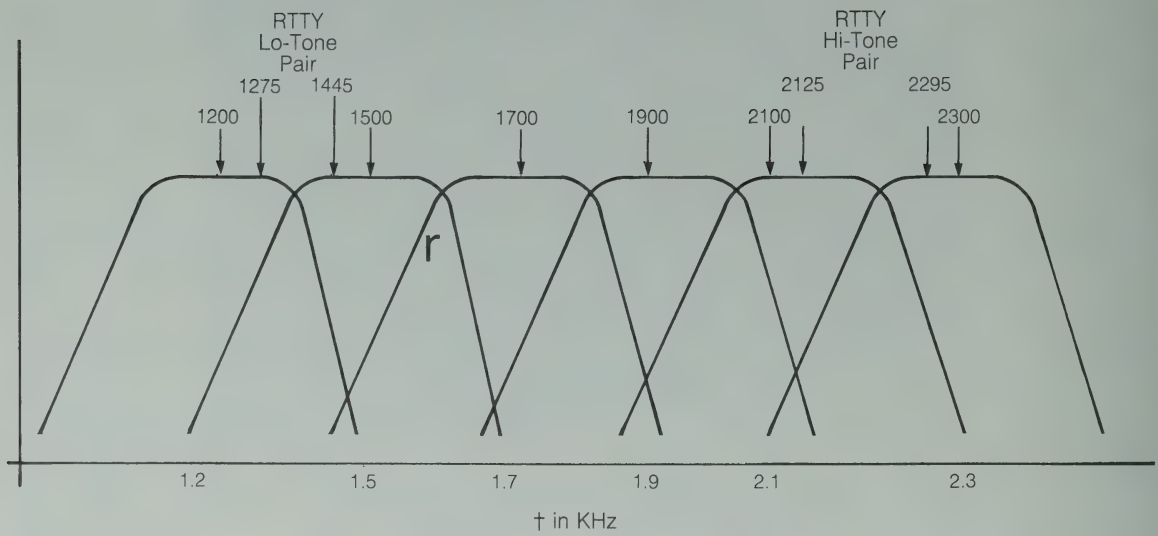


Figure 5-23 *Bandpass filter response in Blinky "959"*

Figure 5-24 *The AEA AMTOR Terminal features complete remote operations (from computer) for both ARQ and FEC modes. As this book is being written, supporting software is available for the Commodore 20 and 64 with several other computer programs under preparation.*

(does not send ASK's but syncs on other ACK's and prints exchanged data) and FEC modes plus RTTY and ASCII. The unit incorporates an active 4 pole bandpass filter for selectivity and interference rejection. Also included is an AFSK generator and 16 LED tuning indicator. There are no front panel controls on the AMT-1: only tuning and status indicators. All functions and operations are handled by the AMT-1's associated home computer. The unit operates AMTOR at the popularly adopted speed of 100 baud, ASCII at 110 baud and RTTY at 60, 67, 75 or 100 wpm. Narrow shift is featured throughout, with mark at 2125 and space at 2295 Hz. Speeds and tone polarity (normal or reverse) are under software control.

A general outline for AMTOR station assembly is shown in **(Figure 5-25).** The AMT-1 connects to the SSB transceiver's speaker, push to talk and mike lines and to its associated computer via an RS232 interface. This arrangement is the key to controlling AMT-1 functions via the host computer. Finally, software is entered into the computer and the system is ready for action. As this book is being written, application programs are available for the Commodore 64 and VIC-20 Considering the versatility afforded by the RS232 interface, other home computers should also be usable with the AMT-1 during the near future. The determining factors will be proper RS232 compatibility, operation at 75 or 100 baud with (pre-

ferably) full or (alternately) half duplex modes, plus the ability to generate "escape" or "control" codes from the keyboard.

The amateur transceiver used for ARQ mode AMTOR must be capable of relatively fast transmit/receive switching. As you'll recall, this mode is similar to CW break-in; that is, a block of 3 characters are transmitted, then an ACKnowledgement is transmitted by the other station, then the next 3 characters are transmitted, etc. Each "transmit block" is 210 ms long, and each "ACK period" is 240 ms long. Most popular transceivers are capable of these speeds and their transmit/receive relays should survive the workouts (a spare relay might be a good idea, however), but larger relays such as those used in linear amplifiers will probably have excessive delays.

The Forward Error Correction mode of AMTOR doesn't place stringent transmit/receive switching capabilities on the amateur transceiver. Consequently, this mode shows extreme promise. As mentioned in previous chapters, FEC AMTOR is being considered for mass amateur information/bulletin transmissions/relays via Phase III OSCAR satellites. A number of tips and hints for AMTOR operations, including ideas for modifying transceivers for fast ARQ operation, are included in the AMT-1 manual. The AMT-1 software package includes automatic CQ, RY and CW identification plus USOS, 3 canned messages and "quick brown fox" messages. Further software expansions may be available by the time this book appears in print.

THE INFO-TECH M-107 AMATEUR TERMINAL

A very impressive interfacing unit for operating RTTY/ASCII/Morse with a home computer system is the recently introduced Info-Tech model M-107 amateur terminal. A respected name in both commercial/professional and amateur fields for several years, Info-Tech products are manufactured by Digital Electronic Systems of 1633 Wisteria Court, Englewood, Florida 33533. This unit is directly compatible with the Commodore 64 or VIC-20 home computers and Kantronics Hamsoft or Hamtext software packages as supplied, while jumpered connections are provided for interfacing with other home computer and /or software arrangements. In the latter case, TTL level and

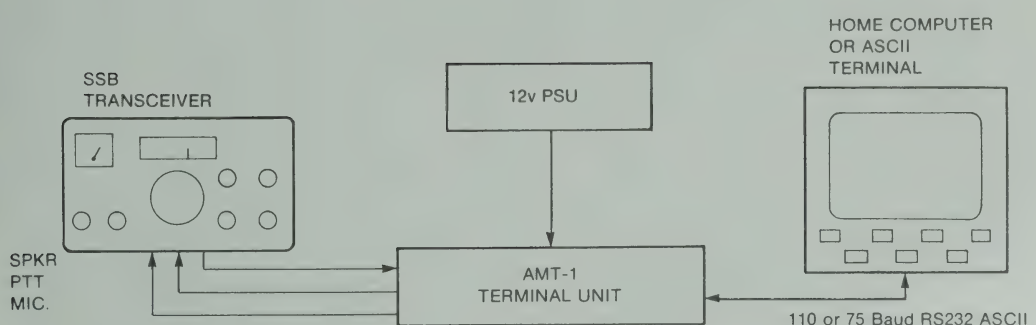


Figure 5-25 *Outline of AMTOR station assembly using the AEA AMT-1. Home Computer may connect with terminal via its RS232 interface (see text).*

RS232 connections (serial data) are employed. One merely solders a few wires to the M-107's supplied interfacing connector.

The interfacing unit itself has a clean and uncluttered appearance with front panel selection of CW or 170/850 Hz RTTY shifts, normal or reversed tone polarity and limiter on/off **(See Figure 5-26).** There's a bar-graph signal tuning indicator plus LEDs for CW, mark, space, transmit and power. During operation, signals are tuned for maximum bar-graph indication and consistent flicker of the mark and space LEDs. Both mark and space filters are employed, and the unit can continue copying on one frequency if the other becomes affected by interference or fading. The dual LEDs are quite useful during such times as they provide visual indication of operating conditions.

The unit's limiter circuit is quite useful during periods of marginal copy or fading, as it also increases the interface's input gain. This feature can be used during either HF or VHF AFSK operations. "Light limiting is provided when the front panel limiter switch is off."

Setting up an Info-Tech M-107 amateur terminal and home computer for RTTY/ASCII-Morse operation with one's HF or VHF station is relatively simple and requires only a few minutes time. An example of those interconnections is shown in **(Figure 5-27).** The computer-to-interface cable is supplied with the Kantronics software. The connector on one end of that cable is replaced with a 7-pin DIN plug for mating with the M-107's socket (This simple 15 minute procedure is fully outlined in the M-107's manual). A separate multipin plug and cable are then used for mating all connections to the station transceiver. A separate 3 conductor ¼ inch stereo-type socket is included on the M-107's rear panel for oscilliscope connections, if desired (a summary of oscilliscope connections for tuning aid indication and illustrations of patterns is included in Chapter 8). Essentially, that's all there is to interconnections. Add software and unit power supply's, and the neat "two cable system is ready for operation." The M-107 will key transmitter push-to-talk lines up to 28 volts DC at 200 ma., and a schematic for a simple relay keyer is included in the manual for interfacing with older transceivers which might exceed that rating. The transmitter's CW keying may be direct, cathode or grid block.

Figure 5-26 *The Info-Tech M107 Amateur Terminal is a professional designed unit especially adapt to use with the Commodore Computers and Kantronics Softwares.*

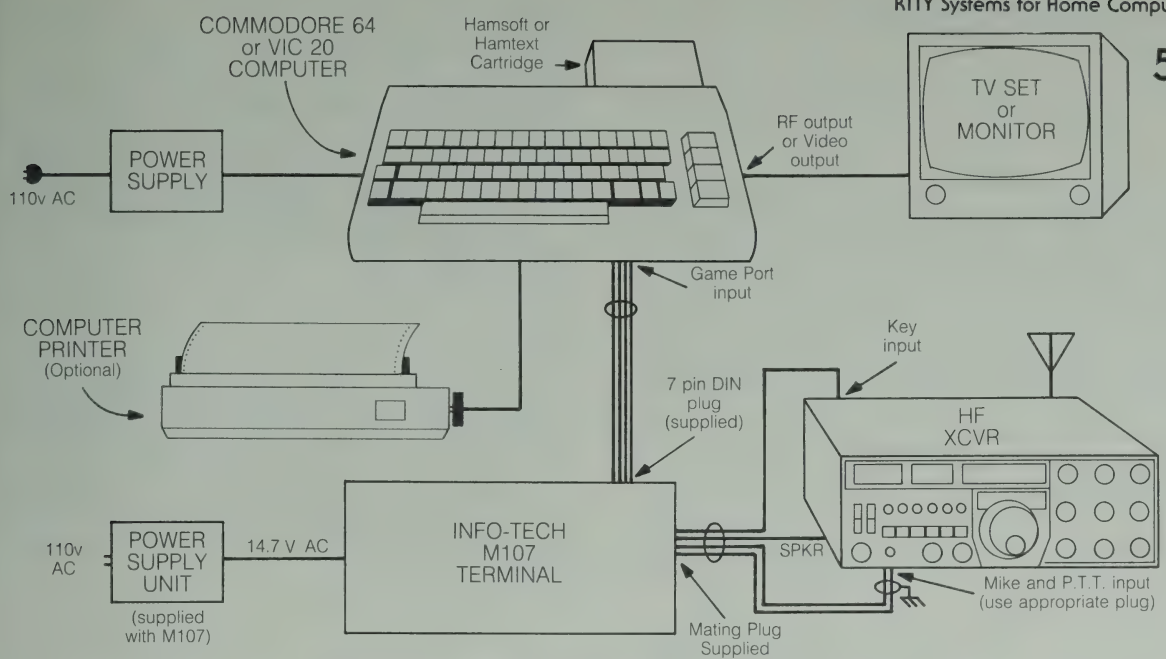


Figure 5-27 *Interconnecting layout for Info-Tech M107 and Commodore computer system with Kantronics Software. Other computer/software interconnections are configured similarly.*

The maximum ratings are 150 volts DC at 100 ma. Finally, the M-107's AFSK output (which connects to the transmitter's mike input) is continuously adjustable from zero to one volt peak-to-peak output.

Assuming the Kantronics Hamsoft of Hamtext is used with this M-107 amateur terminal, operation will generally follow that software's associated manual. The Hamtext package provides for use of the Commodore printer for hard copy, if desired. If other software is used, its accompanying manual for computer operation should likewise be followed. It should also be obvious that other RTTY-related features such as canned messages, type-ahead buffer, split screen display, electronic mailboxing, etc., are direct software functions. All aspects considered, however, the Info-Tech M-107 amateur terminal is an outstanding transceiver-to-computer interfacing unit with quality performance and a very promising future.

HAL CRI-200 RTTY COMPUTER INTERFACE UNIT

Another recent entry into the expanding lines of RTTY equipment is the new unit recently introduced by HAL Communications Corporation, Box 365, Urbana, Illinois 61801. The HAL Corporation has been a pioneer in amateur RTTY equipment. The CRI-200 is a medium priced and very impressive unit that was designed to interface with almost any of the late model home computer systems. The CRI-200 requires a simple hook-up between the transceiver for copying and sending radioteleprinter (RTTY) and Morse Codes. One of the most novel features of this new unit is the LED matrix tuning scope which simulates the display of a RTTY tuning oscilloscope. As you tune a signal using the CRI-200 with LED matrix, the object is to make the two crossed ellipsis as large as possible. The matrix pattern also indicates the direction to tune the receiver by showing which way the display is tilted. The receive RTTY shift can be fixed at 170 Hz or varied from 80 to 975 Hz, and therefore will cover the 425 and 850 Hz commercial RTTY shifts. RTTY transmission can be accomplished by frequently shift keying (FSK) or through the transmitter microphone input using the AFSK transmit tone keyer. The CW receive filter is centered around 800 Hz (internally adjustable) and the unit will key solid state or tube type radios. The CRI-200 will interface to all popular computers and software programs on the market which allows you to choose any one of a number of successful RTTY and Morse software programs available.

Additional features of the CRI-200 are as follows: Full 2-tone mark and space RTTY demodulation, plus or minus CW key output to transmitter, computer interface for RS232C or TTL, totally isolated relay PTT switch cir-

cuit, unit uses standard 4 pin mike connector and standard computer I/0 connector with provisions for spare I/0 connectors for custom set-ups, unit has built-in 120V/ 60Hz power supply packaged in a quality metal cabinet measuring 10″ W x 2.4″ H x 7″ D. The HAL CRI-200 is totally compatible with the HAL ARQ 1000 AMTOR unit. Flexibility is the key word with this good piece of equipment.

SUMMARY

This chapter has presented an overview and cross section discussion of many computerized RTTY systems available at the present time. As you can logically surmise the amount of financial involvement can range from relatively inexpensive to noticably large investments. Selecting and enjoying a system, however, is an informative and rewarding experience. Rest assured that whatever system you select, the overall results will be quite acceptable. They all perform extremely well.

RTTY is in the midst of numerous changes and innovations on both the amateur radio and commercial levels. Assembling information on equipment is thus a precarious situation: new companies and manufacturers are joining the action daily. Others may devote their major efforts to product perfection rather than advertising. As mentioned previously, it's actually impossible to include all commercially available equipment in this book. We thus suggest in that respect you review current amateur radio magazines (CQ, QST, 73, Ham Radio, Worldradio, RTTY Journal, Computer Trader, Popular Communications, etc.) for the latest word on equipment and manufacturers. Enjoy, enjoy!

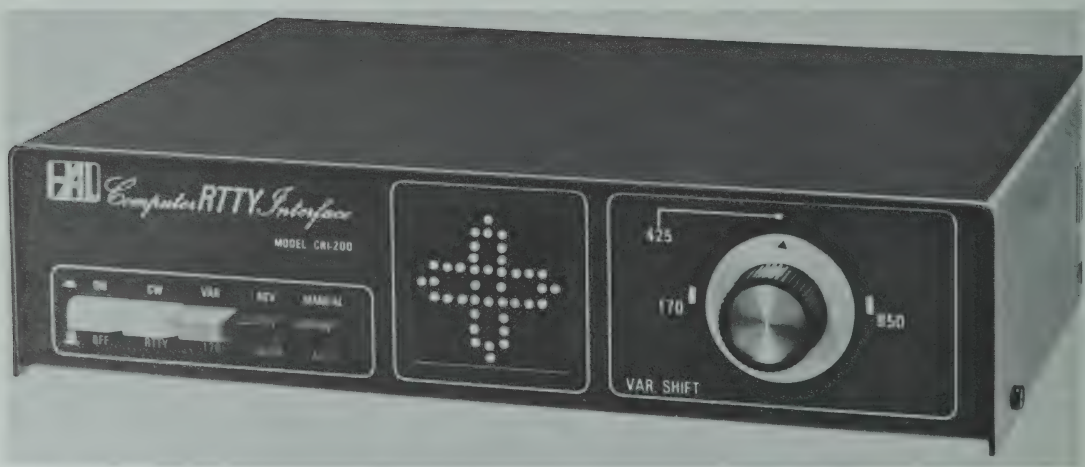


Figure 5-28 *HAL CRI-200 RTTY interface unit with LED matrix tuning indicator.*

CHAPTER 6

DEDICATED RTTY TERMINALS AND SYSTEMS

The area of all-electronic systems for dedicated RTTY, ASCII, and CW operations has grown significantly during recent times and the resultant units are capable of some rather fantastic operations. Dedicated RTTY terminals have proven to be highly immune to RF levels and generally somewhat easier to operate than home computer-type counterparts. Indeed, such dedicated systems are built "from the ground up" specifically for amateur radio type communications. One easily understood difference between RTTY-adapted home computer systems and dedicated terminals involves the use of a "break" key. A home computer uses this key to "break sequence" of its existing program. . .usually to perform some non-related function (which may also call for loading another program). The non-computerist might think of this key as a "panic button". . .a way to halt or restore the computer to itself when things become jumbled. Dedicated RTTY/ASCII/CW terminals use the "break" key for breaking into the transmit mode and sending a transmission or reply without disturbing the contents of their type-ahead buffer. Assume you are in communication with another amateur and typing a "next transmission" reply while receiving the other station's text. Suddenly he asks if you've seen the new Kamakazi 5000 transceiver with its mating Yokahama Z amplifier, and "turns it over to you" for a quick reply. If you're running a home computer-type RTTY setup, your options will probably be: 1) delete your type-ahead efforts and reply, or 2) "let him have it" with type ahead buffer information, then reply to his query.

Since dedicated RTTY/ASCII/CW terminals don't require operator-loaded software upon powerup, they are thus easier to use. Most units "come up" with normal RTTY formats such as 170 Hz shift. "High Tone" pairs, 60 word per minute speed, etc. This consideration allows the unit to move into action as soon as desired. Changing speeds and modes on dedicated systems is also a simple and easy maneuver. Separate keys or simple "1-2 punch" commands usually accomplish these moves in an effortless manner. Dedicated terminals were also designed to work at maximum efficiency with tape drives, printers, etc. This means storing incoming or "pre-typed" outgoing information on tape and later retrieving that information is a natural part of their operation.

Some of the especially attractive special features which are presently available with many dedicated RTTY/ASCII/CW systems are (unattended) selective calling (SELCAL) and electronic mailboxing operations. These concepts open a complete new world of amateur communications which are limited only by one's imagination. Visualize, for example, setting up your station for a message exchange with a distant amateur while you're asleep at night. The DX station calls (either via RTTY or CW, as preplanned), and gives a brief "inquiry." Your station responds with a pre-established code, and communications are established. Several messages follow: one for you and 3 or 4 which your terminal will hold and relay to specific other stations when they later "call in to check their mail." The next morning, you check the electronic mailbox and read whatever number of stored messages desired plus leave a return reply for later communications with the DX station. One by one, the other stations "QUERY" your station and receive their messages. . .and maybe leave return replies (being the first kid on the block with a new toy is wonderfully difficult!). Returning home in the evening, you once again check with the station setup to learn who retrieved messages, who sent messages and the times of those activities. Far-fetched views of the future? Indeed not! That was merely an example of amateur radio communications today which are presently available with commercially manufactured terminals, such as those discussed in this chapter.

Now let's take a close look at some of the unique features which give dedicated RTTY/ASCII/CW terminals their glamour and add a truly new meaning to the term "full featured."

One of the oldest and most commonly known special features of RTTY is **autostart.** Essentially, this concept

allows an RTTY station to continuously monitor one frequency (that to which the receiver is tuned) and automatically print a readout of any and all on-frequency activity. The attractive point of autostart is unattended reception of all messages and/or bulletins while the operator is out of the "shack" or radio room. The unattractive aspect of autostart is continuous printout of on-frequency transmissions, regardless of the intended receiving party (your trash can fills with worthless messages). **WRU,** or Who Are You, is a concept whereby an unattended RTTY setup monitors a frequency but doesn't perform any functions until addressed by a pre-established code. The terminal will then answer back with a pre-established response. As an example of WRU, assume a station "comes up" on frequency and call "K4TWJ QRV?" The WRU - equipped setup would then respond with "K4TWJ HR, GA" (go ahead). The attractive point of WRU is thus an automatic and positive response to queries. . .even during operator absence. Assuming autostart or SELCAL is also used with this setup, the calling amateur can then leave a message with your terminal for later reviewing.

It's also interesting to note at this point that many of the dedicated RTTY/ASCII/CW terminals can utilize their special feature (WRU, SELCAL, electronic mailboxing, etc.) on **both RTTY and CW modes!** This aspect can open new horizons in HF operating and DXing? Interested? Read on!

SELCAL, or selective calling, might be considered as a "modern version" of autocall. Here, the operator programs a special password or group of characters into his terminal for "selective monitoring." Regular on-frequency activity will no longer affect his system, however a specially-coded sequence or password will enable the system's printer and recorder. Using this arrangement, only messages specifically addressed to a station are recognized (the trash can fills with important messages!).

Electronic mailboxing is an extremely attractive and useful concept which is rapidly growing in popularity. Indeed, this is the general concept behind data packet networks and amateur traffic systems of the future. Using electronic mail, an amateur can generate a number of messages for different stations and protest each from "open transmission" with a mutually-understood password. A number of unprotected messages can also be placed in the mailbox for general user "billboard" readout. Later, each user or member of the group can poll the mailbox and/or billboard and read messages. Response and other "billboard announcements" can also be entered into the systems, once again setting the flow of information in action. Some mailbox systems are relatively small, storing received messages and messages to be transmitted. Other mailbox systems are quite large, handling hundreds of messages and sorting them in various formats, etc. The attractive aspect of electronic mailboxing involves unattended operations. A question may arise concerning legality of transmissions involving electronic mail and SELCAL. Since "the other station" is apparently conducting a one-way transmission, such queries may seem logical. Such is not the case, however: unattended terminals using electronic mail or SELCAL transmit WRU acknowledgements to the "other station." That confirms the ensuing transmissions are being received. . .and will soon be answered.

The following pages of this chapter will overview a number of commercially manufactured dedicated RTTY/ASCII/CW terminals and related items which are available at the present time. The purpose of this overview is to familiarize you with the general area of dedicated RTTY/ASCII/CW units and their concepts. This should not be considered a full market analysis nor a complete review of the considered units. As mentioned in previous chapters, such an all-inclusive report would encompass a vast number of pages. Through the presented overviews, however, you will acquire sufficient knowledge to both understand and appreciate the hookups and capabilities of dedicated terminals. As you'll also notice, interconnecting a dedicated terminal to an existing amateur radio setup is quite straightforward and simple. Connections to an HF transceiver are via the speaker, microphone/push-to-talk and key lines. In many cases, that's all there is to the hookup! Other times, the terminal is strictly a data processing unit which is interconnected to an external RTTY demodulator and AFSK generator unit.

Again we emphasize to both readers and manufacturers that inclusion of all marketed RTTY equipment and/or all features of equipment considered herein is essentially an impossibility. New companies are joining the action daily; concepts and parameters are undergoing modificatons (AMTOR, for example, has recently been authorized for amateur radio use and the specific data speeds may be altered before everyone agrees on a "final format"). Additionally, any manufacturer has the prerogative to alter capabilties and options of his unit. Armed with this chapter's general knowledge, however, you will be able to understand and recognize the capabilites and techniques of dedicated terminals available both today and tomorrow.

THE MICROLOG ATR 6800 SYSTEM

A very attractive and truly full featured dedicated RTTY/ASCII/CW system which can be used on a direct "plug-in" basis with most popular amateur gear is manufactured by Microlog Corporation, 18713 Mooney Drive, Gaithersburg, Maryland 20879. The setup consists of two units: a desktop terminal containing full system electronics including RTTY demodulators, AFSK signal generator, keyboard, etc., and a separate video display unit. **(See Figure 6-1).** Hardcopy printouts of information may be acquired by connecting a Baudot machine (such as a Model 28 teleprinter, etc.) or by using a home computer-type printer and the system's internal Baudot to ASCII converter feature. Conventional RS232 levels are provided via a rear RS232 connector. One of the particularly unique features of the ATR 6800 system is its secondary function as a home computer (a sort of "reversed switch" from home computers used for RTTY). Using the Motorola M6800 microprocessor and related BASIC language, the system features 4K bytes of RAM (working memory) which can be extended to 16K. The massive manual supplied with the ATR 6800 includes vast amounts of programming information, examples and sample programs. A number of Motorola 6800-related microcomputer books are also listed. The ATR 6800 is enclosed in a heavy aluminum enclosure, making it one of the very few RFI immune home computers. . .which is actually a misnomer since the ATR 6800 is primarily a dedicated RTTY/ASCII/

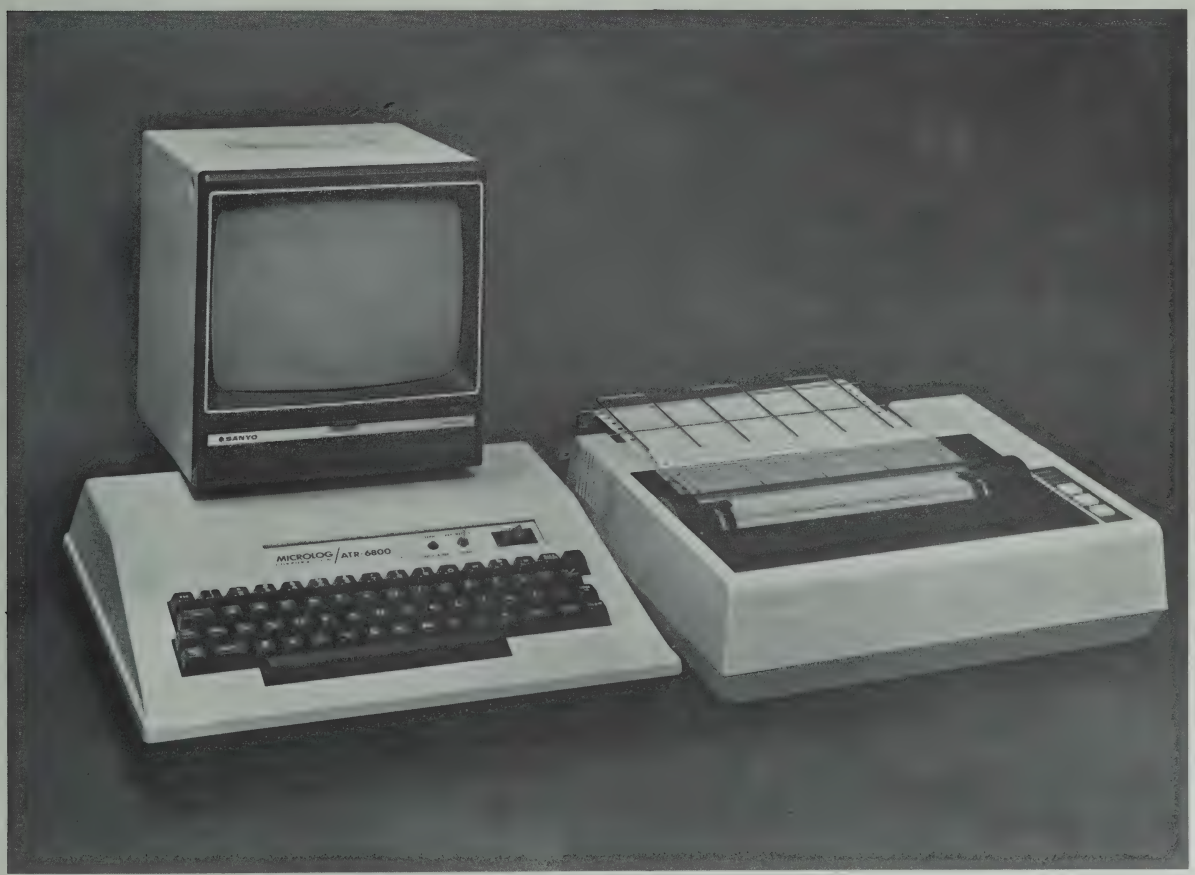


Figure 6-1 *The Microlog ATR 6800 dedicated RTTY/ASCII/CW system is complete within itself, requiring only an external video monitor for full operation. All parameters are switched from the keyboard proper.*

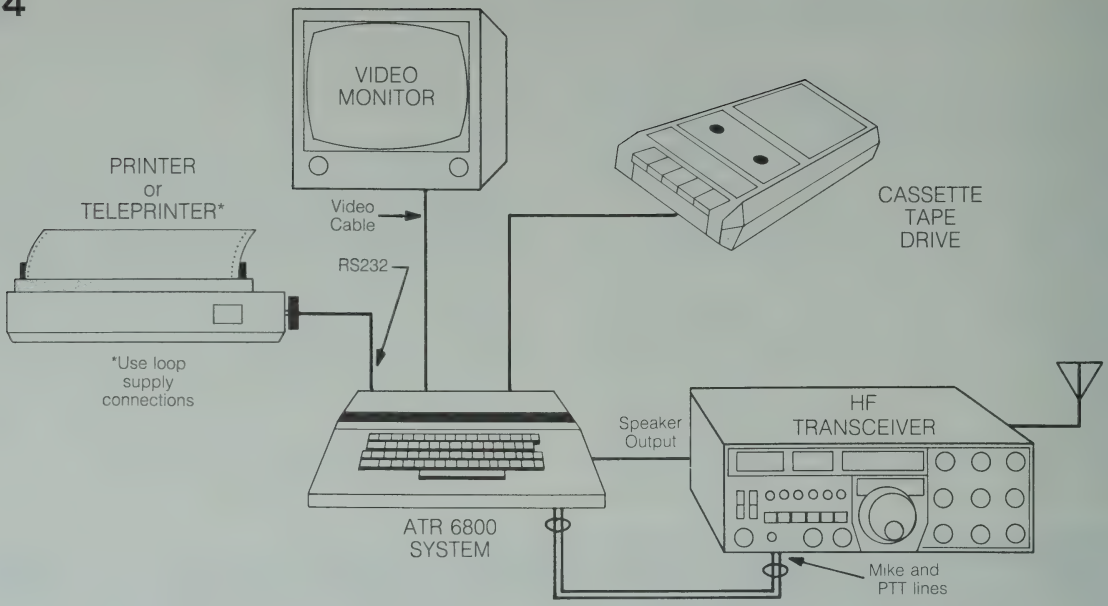


***Figure 6-2** General outline of the Microlog ATR 6800 system, illustrating interconnections with an amateur setup.*

CW terminal/system. Indeed, one may never know of or use the internal computer unless desired at a later date. When initially powered up, the system assumes its normal functions as an amateur terminal. There are no programs to load, commands to "call up," etc.

An outline of the ATR 6800's setup and interconnection with one's HF setup is exemplified in **(Figure 6-2).** The self-contained terminal and keyboard unit connects to the amateur transceiver via its speaker, mike and push-to-talk lines, while the video display connects to the terminal/keyboard unit by a short coaxial cable. If an external printer or cassette tape drive are used, those items simply plug into sockets on the terminal's rear. Essentially, that's all the connections required for complete operation of the ATR 6800. Quick, neat and simple. . .but an elaborate unit capable of superb performance.

The Microlog ATR 6800 operates RTTY and ASCII of 170, 425, 850 Hz shift (or any "in between" shift), high or low tone pairs, normal or reverse tone polarity and speeds of 60, 66, 75, 100 or 132 words per minute on Baudot or 110, 300, 600, 1200, 2400, 4800 or 9600 baud on ASCII (parameters for both transmit and receive). Morse code operation is keyboard-selectable from 5 to 199 words per minute, with the system tuned to receive an 800 Hz tone from the receiver. An LED tuning indicator is included, plus there are outputs provided for oscilliscope displays.

The ATR 6800 employs a split screen display of received and type-ahead buffered information. The location of that split line can be moved anywhere on the screen as desired, and either normal (black letters/white background) or reverse (white letters/black background) video may be used. There are also two modes of visual display: normal (24 lines, 24 characters per line) or zoom (12 lines, 20 characters per line). Looking at the system's photo **(Figure 6-1),** there are only two simple toggle switches visible. The previously described variables are under direct keyboard control, usually requiring a simple "1, 2 punch" for their switching selection. Since the system is "preloaded" with the most common RTTY/ASCII/CW parameters the possibility of getting lost among the myriad of possible functions is almost nil. Like many dedicated systems, the ATR 6800 features information-transmit modes by individually typed characters, by complete words or by complete lines.

Autostart, SELCAL and WRU capabilities are standard features on the ATR 6800. A 15-character user-designated code is used for enabling WRU and SELCAL functions. There are also 4 separately designated SELCAL memories which can be used for independently storing messages from various stations. Naturally, full cassette interfacing is provided, along with full battery backup of memories, operation for "field day" use).

Being a true state-of-the-art terminal, the ATR 6800 is also supplied AMTOR-ready. One thus acquires a unit containing an 1800 character type ahead buffer, 10 programmable "canned" messages with storage of up to 80 characters each, operation with any popular mode and speed, plus a powerful home computer. The extensive manual supplied with the unit simplifies system hookup and operation (separate discussions are included on numerous Icom, Yaesu, Kenwood, Drake, etc. units).

Finally, the ATR 6800 features an optional electronic mailbox which can be used for unattended message storage and retrieval. Using the main user-established access codes, remote users can access the system, open the mailbox, leave or retrieve messages with "headers" designating to whom intended (the electronic address), and the message(s) proper. Best of all, the special features of WRU, selcal and electronic mailboxing may be used on RTTY, ASCII or CW.

THE HAL DS 3100 ASR TERMINAL

An outstanding and quite sophisticated RTTY/ASCII/CW terminal capable of applications and expansions according to one's interests is the DS 3100 ASR unit manufactured by HAL Communications Corporation, Box 365, Urbana, Illinois 61801. The terminal proper consists of two interconnected pieces: a bottom keyboard and electronics unit and an upper video display unit. The

Figure 6-3 *HAL Communications top of the line DS 3100 terminal features an integrated keyboard and monitor design with multiple capabilites and options. An external modem (such as the ST 6000) is required.*

RTTY demodulator and AFSK generator circuits are not included in this terminal proper, but are a separately purchased item. HAL Communications recommends using their top-of-the-line Model ST 6000 RTTY demodulator/AFSK unit and the choice seems quite logical, as ST 6000/DS 3100 interconnecting cables provide direct plug-in capability, and using anything less than the elaborate ST 6000 could compare to putting four bald tires on a new Cadillac. A picture of the DS 3100 terminal is shown in **(Figure 6-3).**

The unit features either split screen display of received/transmit-type ahead buffer or full screen display of received information. Ten programmable "canned" message buffers of 32 characters each are provided, along with a transmit text buffer which will hold up to 50 lines of information. The receive buffer will hold up to 150 lines of text. Since the screen displays 24 lines of text (with 72 characters per line), the additional "buffered lines" may be scrolled on the screen for review. The terminal will operate either half or full duplex. During half duplex (conventional operation), transmitted information can be echoed into the full screen receive buffer and displayed at low brightness: a rather unique means for reading "both sides" of a conversation. All terminal functions are controlled by the keyboard, while status indicators appear on the unit's screen. The terminal connects to its "outside world" via a 20 or 60 ma. RTTY local loop or an RS232C interface. As previously mentioned, this may be provided by the HAL ST 6000 modem. The professional looking unit is quite attractive and adaptable to numerous station layout patterns.

An outline of the DS 3100 terminal, ST 6000 modem and amateur transceiver interconnection is shown in **Figure 6-4.** Shielded cables are used for directing speaker audio to the ST 6000 (or a similar SSTV demodulator/AFSK generator unit), and for directing AFSK and push-to-talk (transmit) keying signals to the transceiver. The ST 6000 unit's RTTY loop output is then connected to the DS 3100 terminal's rear panel input. A separate ground is run between each of the units for prevention of RF feedback loops or extraneous hum, and the system is ready for use.

The DS 3100 operates RTTY at 60, 66, 75, 100 and 132 words per minute and ASCII at 110, 150, 300, 600, 1200, 1800, 2400, 4800 and 9600 baud. Morse operation is 1 to 199 words per minute, with automatic tracking. Shifts and audio frequencies utilized, you'll recall, are a

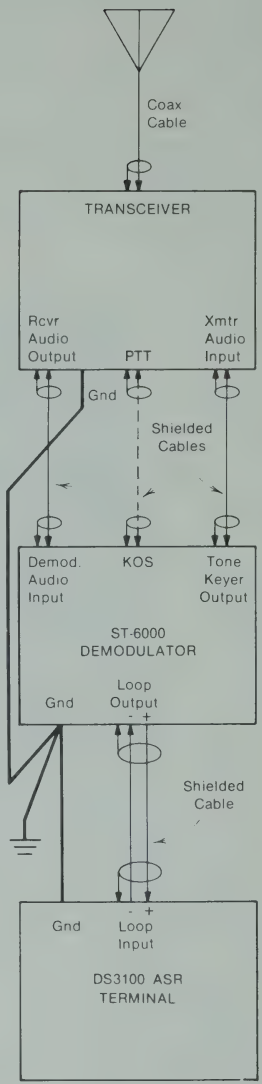


Figure 6-4 *Interconnection layout for the HAL DS 3100/ST 6000 system.*

function of the ST 6000 modem which will be discussed presently. The DS 3100 may be programmed to transmit data via the character, word or full line mode. Information held in the ten 32 character message buffers employs EAROMs: Electronically Alterable Read Only Memory(s). There's also an internal 24-hour clock (with on-screen display), an auto-CW ID key for RTTY operations and a 10 character-programmable WRU auto response memory which will key a rig, delay, send a WRU message, delay and deactivate the rig.

The HAL ST 6000 demodulator operates 170, 425 or 850 Hz shifts with either "high tones" (U.S. standards) or "low tones" (European standards) on both transmit and receive. **(See Figure 6-5).** Accepting either teleprinter loop (20 or 60 ma.) or RS232C inputs, the AFSK circuit produces a continuously variable output level. The demodulator circuit includes either hard or soft limiting, a multipole active filter "front end" and a Automatic Threshold Circuit (ATC) which acts as an "RTTY squelch" in establishing the weak-signal dropout point. An oscilliscope "cross hair" display is included for tuning assistance. All aspects considered, this unit is a super demodulator/AFSK generator which would complement any setup.

There are several optional special features which significantly expand the basic DS 3100/ST 6000 setup; primarily the MPT 3100 program for electronic mailboxing and message processing (which also requires installation of an MSO 3100 board), a DSK 3100 disk drive, a C1 cable set and an ARQ 1000 AMTOR modem. The MPT 3100 Message Processor Terminal package is particularly designed for the amateur traffic operator and/or electronic mailboxing enthusiast. Approximately 32,000 bytes of storage (32,000 characters) are provided, which translates to approximately 100 typical length messages. The messages can be sorted in various ways, such as geographical location, and then transmitted in batches with attached serial numbers. The electronic mailbox will permit users to read, write and delete messages remotely. Files may be restricted to specific parties via user-programmable passwords or merely left "open access" in a billboard fashion as desired. Both of the previous functions can be operated in the unattended mode, if desired.

Figure 6-5 *The HAL ST 6000 is a full featured, no compromise demodulator/AFSK generator unit containing a built-in tuning oscilliscope.*

Figure 6-6 *The HAL DSK 3100 dual disk drive which can be used with the DS 3100/MPT 3100 system for mass storage and processing of electronic mailbox messages.*

A vast number of additional features are included in this system. Additional details are available from HAL Communications Corporation.

The HAL DSK 3100 dual disk drive **(Figure 6-6)** extends the DS 3100/MPT 3100 system's message storage capacity to more than 326,000 characters; the exact amount being determined by how many files are to be stored (maximum files: 511). The disk drives use conventional 5¼ inch floppy disk; single sided, double density. The unit is keyboard-controlled from the terminal.

The HAL DS 3100 ASR and accessories may be configured in a number of ways to fit one's setup and needs. The system represents one of the most elaborate electronic terminals introduced to the amateur world. The units are not inexpensive, but resale value is reasonably good. Details on the ARQ 1000 are presented later in this chapter.

THE HAL CT 2200 TERMINAL

While many dedicated RTTY systems are available in a "single unit configuration," the concept of a "separate component design" may be the perfect choice for one's existing setup. If an older model teleprinter is presently used for occasionally desired hard copy printouts and an oscilliscope tuning aid is already in use, for example, adding a modern terminal with its separate keyboard and video display may hold merit. The HAL CT 2200 unit forms the basis for such a system, interfacing with the separate KB 2100 keyboard, KG 12 video monitor, RS 2100 RTTY scope and/or ARQ 1000 AMTOR interface as desired. Likewise, sequential purchase of units according to one's budget will allow the amateur RTTY system to "grow" with one's interest.

The CT 2200 unit is a full-blown setup containing RTTY/CW demodulators, AFSK generator, either split screen transmit/receive display or full screen receive display, 8 canned message buffers, dual tuning indicators, RTTY loop or RS232S connections, and much more. The mating and optional KB 2100 keyboard connects via a retractable "curly cord" for either desktop or lap use, while the video display connects via a simple coaxial cable. Approximately 17 rear connectors (mostly RCA phono type) are provided for audio, RTTY loop, RS232 serial data, oscilliscope, tape recorder, key, keyer, etc.

The unit features either smooth scroll or separate page displays formatted in 48 or 96 lines of either 72 or 36 characters per line. All operating parameters are push button selected on the CT 2200 panel. This included RTTY/ASCII/CW speeds, RTTY shifts, high/low tones, normal/reverse video, RTTY "diddle" ("characters" signal) audio levels, all transmit/receive functions, plus sta-

tus displays selection and a 5-LED tuning indicator. **(See Figure 6-7).**

An illustration of the CT 2200 system interconnection is shown in **(Figure 6-8).** The station's transceiver is interfaced via speaker, mike and push-to-talk lines while the video monitor connects via a coaxial cable. The KB 2100 keyboard (which may be placed 2 or 3 feet from the CT 2200) connects via its supplied cable. The optional cassette drive and printer connect via user supplied cables with RCA phono plugs. The printer may be a serial ASCII home computer unit (interfacing circuitry may be required) or an older model teleprinter (the CT 2200 will key its loop supply). If all of the previously mentioned interconnections seem too time consuming, HAL Communications can provide a complete C_2 cable set for the system.

The CT 2200 system operates RTTY at 60, 66, 75, 100 and 132 words per minute, ASCII at 110, 150, 300, 600 and 1200 baud, plus CW at 5 to 100 words per minute. 170, 425 or 850 Hz shifts and either high or low tone pairs are push button selectable. There's also connections provided for Bell standard 202 or 103 modems which are used for telephone communications between computerized terminals. Selection of screen "page" display, character format/size, upper status lines and normal or reverse video are also push button selected. An on-screen RTTY tuning bar permits easy tuning without shifting view to the CT 2200, if desired (both tuning aids operate simultaneously). In addition to a type-ahead buffer, there are 7 canned message buffers of 256 characters plus one additional 158 character buffer, 2 WRU buffers (user programmable and codable), and a codable selective call auto-copy feature which activates the recorder or printer for unattended operation. An expanded canned message ROM capable of storing up to 2000 characters is an optional item known as the MSG 2100. The overall capabilities and actual operations of the CT 2200 are quite impressive and flexible to suit anyone's desires.

***Figure 6-7** The HAL CT 2200 terminal employs a bank of front panel switches for selection of operating parameters while the separate keyboard is used for entering text to be transmitted. The arrangement is flexible and effective.*

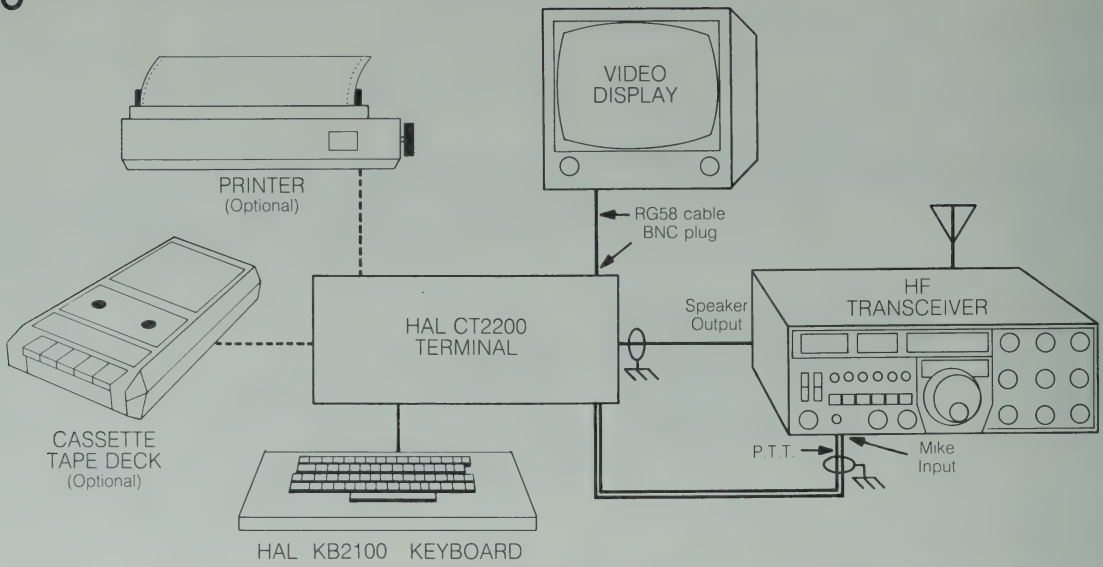


Figure 6-8 *Outline of interconnections for the HAL CT 2200 "Component RTTY system." Cassette deck and printer are optional. Keyboard connects to terminal via "curly cord."*

THE HAL CWR 6850 PORTABLE RTTY SYSTEM

Amateurs interested in a full featured yet compact RTTY/ASCII/CW system for limited space or portable setups could easily find the CWR 6850 quite attractive. Everything except the keyboard is contained in a sturdy cased unit hosting a full array of front panel switches and video display. **(See Figure 6-9).** The external KB 6850 keyboard is included with the system, and connects via a thin supplied cable. Alternately, the terminal can be operated separately as an RTTY/ASCII/CW reader. The system may be fully powered from a 13.8 volt DC 1.6 ampere source for field/portable use. Everything one could desire is included in the CWR 6850 package; all RTTY modes and speeds, type ahead buffer, 4 page display, 6 canned messages, etc. The internal 5 inch (diagonal) screen display is green P31 type. The beauty of this unit is its portability (12.75 by 5 by 11.5 inches) and its ease of set up in a variety of locations.

Interconnection of the CWR 6850 with one's existing amateur setup is the epitome of simplicity **(See Figure 6-10).** Merely cable to speaker and mike/push-to-talk lines, and it's ready for action. There isn't any keyboard programming required for system operation: switches on the CRW 6850 front panel selects modes, speeds, shifts, USOS, etc. If you have a sincere distaste for "computerized" type systems and prefer the more "old fashioned" switch selection type of operation, you'll truly enjoy the CWR 6850. Looking at the unit's rear panel, there's connections for an external printer, key input and output, transmitter FSK keying, tape drive, AFSK output, plus an oscilliscope mark/space crosshair display.

Operating the CWR 6850 is a true "no compromise" situation which is rather unique for such a small package. RTTY speeds are 60, 66, 75, 100 and 132 words per minute, ASCII speeds are 110 and 300 baud and CW speeds are 3 to 35 words per minute. Shifts of 170, 425 and 850 Hz, plus either high tone or low tone pairs, are push button selectable as desired. The unit's display is formated in 20 lines with 32 characters per line and a 4 page switch-selectable display. Page 1 contains 15 lines of received information and 3 lines of type-ahead buffered text. Page 2 contains 3 lines of the most recent received information, and 15 lines of type-ahead buffered text. Page 3 carries 3 lines of the most recent received information, 3 lines of the type-ahead buffer and 12 lines of canned message text. Page 4 carries 20 lines of received information. Unaccounted lines in the previous breakdown are blank. As previously mentioned, there are 6 canned message buffers. Each will store up to 64 characters. The resultant capabilities of "mixing and matching" size of transmitted text, received text and canned mes-

sages results in a very impressive "stand alone" RTTY unit.

The CWR 6850 can provide hard copy of received information via its external printer connections which use a 12 wire, 7 bit Centronics-compatible output. These type connectors are quite popular in home computer setups, thus interconnections with many printers is simplified. The rear panel phono connectors for an oscilliscope may be used in a conventional "X-Y" manner, or they may be connected to the HAL RS 2100 RTTY scope. Alternately, one may use the LED indicators on the CWR 6850 front panel instead of an oscilliscope tuning aid.

The compact CWR 6850 telereader is designed to mate in both operation and appearance with one's existing amateur setup. The "break apart" versatility of its external keyboard and its tiltable front bail add extra flexibility to unusual places of operation. . .be it a soft floor cushion on the jagged sealine of St. Peter and Paul Rocks. It's a perfect traveling companion which should appeal to many of today's busy amateurs.

BREAK, PLEASE!

Considering the fact this chapter is covering a substantial amount of ground in both the commercial equipment area and on the various technology levels of RTTY today, let's take a brief break to clarify its purposes and to reiterate some possible overlooked thoughts. Think of this as a sort of informal intermission during a live presentation when the speaker (or in this case, the writer) can talk freely and answer personal questions.

First off, this chapter (and the other two "equipment-related" chapters) contain much more useful information than mere equipment reviews. We all learn better and become more knowledgeble in any area by actually seeing and operating related equipment. That's exactly what we're attempting to accomplish here. Although we can't physically place items in front of you, explain hookups, etc., we're following that same format in written style. Rather than relying solely on what we think you'll

Figure 6-9 *The HAL CWR 6850 illustrates a flexible and interesting approach to RTTY today. The portable terminal unit can be moved around as desired, while the detachable keyboard can be lap-operated quite conveniently.*

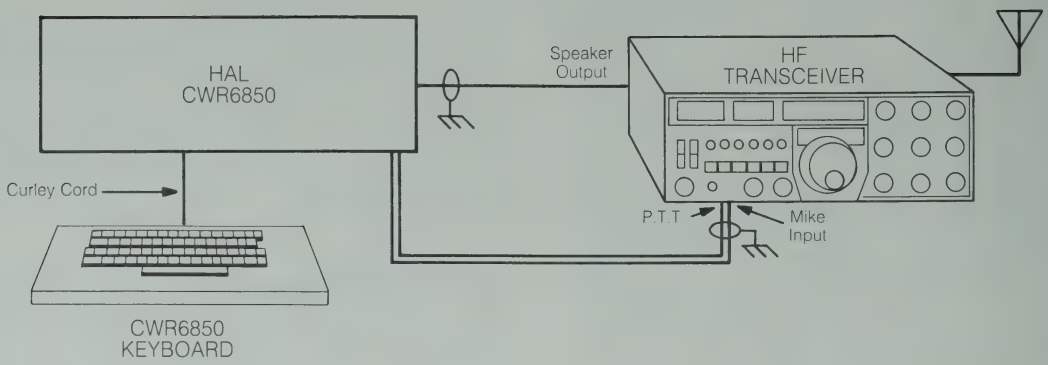


Figure 6-10 *Probably the quickest and easiest-assembled RTTY system anywhere is the HAL CWR 6850 and mating keyboard. The "everything in one box" concept has merit!*

ask (or what we think you should ask), we conducted surveys of related questions and then blended those answers into our writing guidelines. The survey's inputs were received from magazine articles, from on-the-air conversation, from hamfest forums and from discussions with manufacturers and distributors.

As you'll notice, we try to follow a similar discussion format with each system for ease of understanding and interrelating. We first overview the system as if you were visiting our "shack" and seeing it for the first time. Then we "uncover the wiring" and explain how everything is connected. . .many times to the point of cables and plugs, and which ones you must assemble yourself. Next, we explain all operating capabilities and parameters (a demonstration). Finally, we explain the systems special features and options. . .and what they provide. This is the closest approach we know to an actual "in person" discussion.

Some special aspects or features are detailed in one system's discussion more than another. This isn't favoritism; it's logical. Explaining specialties a half dozen times isn't necessary (you would become bored with the book).

Interfacing home computer-type printers with electronic RTTY systems is sometimes a cabling game within itself. This situation is confirmed each month in the various home computer magazines. When setting up for hard copy, we suggest contacting the system's manufacturer for a cable set to mate your terminal and the desired printer. Bear in mind some switches will need to be set for recognizing binary levels, etc. and speed buffering with a certain amount of digital memory may be required. Few printers simply "plug in and run" without interfacings. Some of this chapter's printers are serial data input; some are parallel. The difference? Serial (or series. . .one behind the other) moves data via a single wire and ground. Older teleprinters were serial data. Parallel moves all data bits simultaneously by using a separate wire for each bit (7 wires and ground). Serial printers can be used with parallel output ports provided a storage buffer is used. That buffer would "load" in parallel but output serially one bit at a time to the printer. Some computer buffs sidestep printer problems by initially selecting units with working cable sets. Naturally cables can be homebrewed, but securing accurate data is often difficult.

As this book is being written, the popular AMTOR speed is 132 wpm. This could change in the future. Check monthly magazines to be sure. Since some RTTY terminals do not operate above 100 wpm, some (but not all) AMTOR converters provide speed buffering to 100 wpm. If however, you're using an AMTOR-only setup, buffering isn't a problem.

Finally, the video modulators mentioned in various

chapters are simple units such as employed in video recorders, TV games, etc. They accept "raw" video and audio, and use those signals to modulate a very low signal generator tuned to TV's channel 3 or 4.

THE HAL ARQ 1000 AMTOR TERMINAL

As you'll recall the previous chapter detailed a number of RTTY systems for home computers. Also included in that chapter was an interfacing unit for using home computers with the new mode of AMTOR. Following suit in this chapter, we will now consider an AMTOR unit for use with the previously discussed dedicated RTTY systems by HAL Communications.

The ARQ 1000 Terminal is designed to operate the AMTOR modes ARQ, FEC and FEC/CB (selective broadcast to specified stations only) plus monitor any AMTOR transmission in an automatic mode selecting manner (sometimes called ARQ listen, although in this case both ARQ and FEC are included). **(See Figure 6-11).** The unit is designed for use with the HAL DS 3100/ST 6000, the CT 2200 or the CWR 6850 systems. It connects between the demodulator and terminal via a simple cable hookup. That arrangement allows front panel-bypassing of the ARQ 1000 for normal RTTY/ASCII/CW operations (due to the required text buffering and character data manipulations, the ARQ 1000 is an AMTOR-only unit). A tuning indicator proper is not included on the ARQ 1000, since that feature is associated with the demodulator unit and/or screen display employed elsewhere in the utilized system.

The unit's front panel exhibits a "clean look" boasting 30 LED indicators and 11 push-type switches. The general style and appearance matches HAL's CT 2200 terminal. The LED's give an impressive display during operation, indicating master or slave format, transmitting or receiving station, in-communications traffic or idle condition, an ARQ repeat LED, error detection LED, plus phasing, overs, SELCAL, etc. Every utilized status can thus be determined in a glance.

Equipping an existing HAL RTTY setup for AMTOR

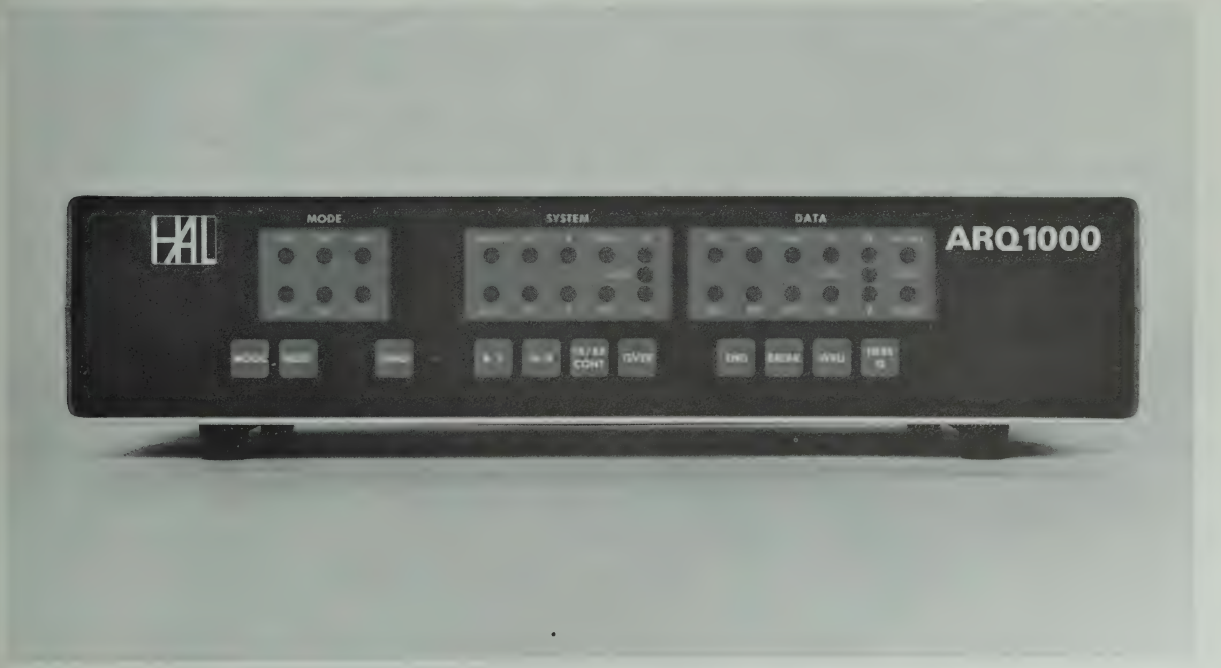


Figure 6-11 *The HAL ARQ1000 AMTOR Terminal is designed for use in conjunction with a dedicated RTTY setup such as HAL's CT2200 system. The ARQ 1000 provides AMTOR capabilities only.*

communications is simply a matter of cabling the ARQ 1000 to one's setup. . .quick and easy. AMTOR, you'll recall, employs the same frequencies and shifts presently used in amateur RTTY. One's existing demodulator and AFSK unit may thus be used. The only "rig stipulation" involves fast break-in type operation for ARQ operation. Again recalling previous theory, a burst of 3 characters are transmitted and acknowledged by the "other" station before the next 3 character-burst is transmitted. Rigwise, the advantage of ARQ operation is a 50 percent duty cycle rather than the 100 percent duty cycle of FEC AMTOR or conventional RTTY. This may thus be analogized to "trading off" continuous transmitter operation for fast breaks in which the rig can cool and relax.

Some of the ARQ 1000's attractive points are SELCAL capability, WRU auto response and a special data inscription option. There's also a sel-fec mode which will invert data pulses before transmission to specially-programmed stations. Considering the overall techniques of AMTOR itself, the previously mentioned capabilties of the ARQ 1000 seem quite logical features. AMTOR, you'll recall, employs a 7 bit character format consisting of 4 "on's" and 3 "off's." Baudot also uses 7 bits, but all characters are not a 4/3 ratio. Likewise, the popular speed for AMTOR is 100 baud or 132 words per minute whereas the popular speed for Baudot is 60 words per minute. AMTOR interfacing units thus afford bit-character translations (1111000 = 1001010, for example), plus error checks during translation (did the AMTOR character contain 4-1's and 3-0's), yes or no response (ACK/NACK), plus bit inversion if desired (1111000 = 0001111) and speed buffering if required (132 wpm input/60 wpm output). The ARQ 1000 handles each of these functions in a very effective manner, and the unit's future success looks quite promising.

THE DGM SRT 3000 SEND-RECEIVE TERMINAL

Setting their own style and approach to the dedicated RTTY terminal field, DGM Electronics, Inc., 787 Briar Lane, Beloit, Wisconsin 53511 produces three rather unique items. One is a send-receive terminal while the other two units are separate transmit and receive items. In looking at these units and pondering their attractiveness to one's existing HF setup, we will begin considera-

Figure 6-12 *Boasting full control of all operating parameters directly from the keyboard, DGM Electronics SRT 3000 is a fully self contained unit requiring only a video monitor for full RTTY/ASCII/CW capabilities.*

tions with DGM Electronic's SRT 3000 send-receive terminal. A picture of the SRT 3000 and a video monitor (indeed, a complete RTTY/ASCII/CW system) is shown in **(Figure 6-12).**

Some of the particularly unique aspects of this system are its "streamlined' design, compact layout and complete keyboard control of all functions. . .from mode and tone shifts to a special CQ key permits immediate keyboard transmission without disturbing contents of the type-ahead buffer). If you're somewhat slow in the Morse copy area, there's also a random CW generator included in the SRT 3000.

Interconnecting this system with one's existing amateur setup is an absolute snap, thanks to a group of rear panel RCA phono sockets **(Figure 6-13).** While a basic setup merely employs speaker, mike and push-to-talk connections, a complete system interconnection guide as illustrated in the SRT 3000 manual is shown in **Figure 6-14.** Note the cassette drive, printer, etc. are optional while the unit proper contains the system's full electronics: demodulators, AFSK generator, a rear speaker, integrated circuit memories, a memory backup battery (which functions when the unit is switched on). Notice, also, the SRT 3000 can be used with a serial data RS232 type printer such as those employed with home computers or with an older model teleprinter (connected via its loop supply). Again, wiring configurations for these items are included in the SRT 3000 instructions manual.

Operating RTTY, ASCII or CW with the SRT 3000 may at first seem unusual, since all parameters including those usually selected via switches are directly keyboard controlled. A "control E" changes RTTY shifts, for example, while "control V" toggles the SELCAL function on/off, etc. In fact, there's "control" functions for almost every letter of the alphabet. . .and that equates to quite a few switch functions. The SRT 3000 operates Baudot RTTY at 60, 66, 75, 100 and 132 words per minute, ASCII at 110 or 300 baud and Morse at 1 to 99 words per minute. All of the "usuals" such as USOS, word wraparound, time display, RTTY "diddle," etc. are naturally included in the system. There are four keyboard-selectable video displays in the system. Three are full screen with keyboard selection of pages while the fourth is a split screen display. Looking first at full screen displays, there is a 24 line by 72 character presentation which has two keyboard selectable pages. Next there's a larger lettered and (for those of us with late night or weak eyes) an easier read presentation of 24 lines with 36 characters per line which has four pages. The next display of 16 lines with 36 characters per line has six pages. The "missing" eight lines (16 lines versus 24 lines) are split between display top and bottom, and left blank. This is the display DGM uses when the display unit is a conventional TV set rather than a closed circuit monitor (an optional or user-supplied video modulator is required). Some TV sets "clip" top and bottom areas of their presentations, thus this consideration seems logically justified. The fourth display is the popular split screen, with received information near the top and type-ahead information near the bottom. The two segments are easily identified, because inverted video is used on one (they are keyboard "toggleable"). Finally, a top line showing all operating parameters plus the time and a bar-type tuning indicator is included on all displays. **See Figure 6-15 and 6-16).** Also featured in this DGM unit are 10 programmable memories of 80 characters each and an approximate 1000 character type-ahead buffer. There's a WRU standard feature which will respond to user-programmed code, activating a transmitter and outputting the contents of memory 1. Both Autostart and SELCAL are included, permitting copy of either all on-frequency RTTY action or only that directed to the specified station.

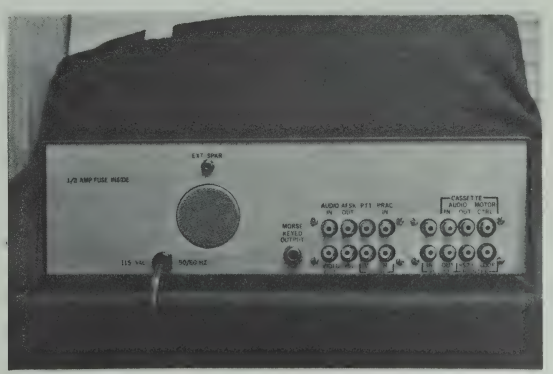


Figure 6-13 *Rear view of the DGM SRT 3000 terminals, showing the bank of phono connectors for mating with one's existing amateur radio setup.*

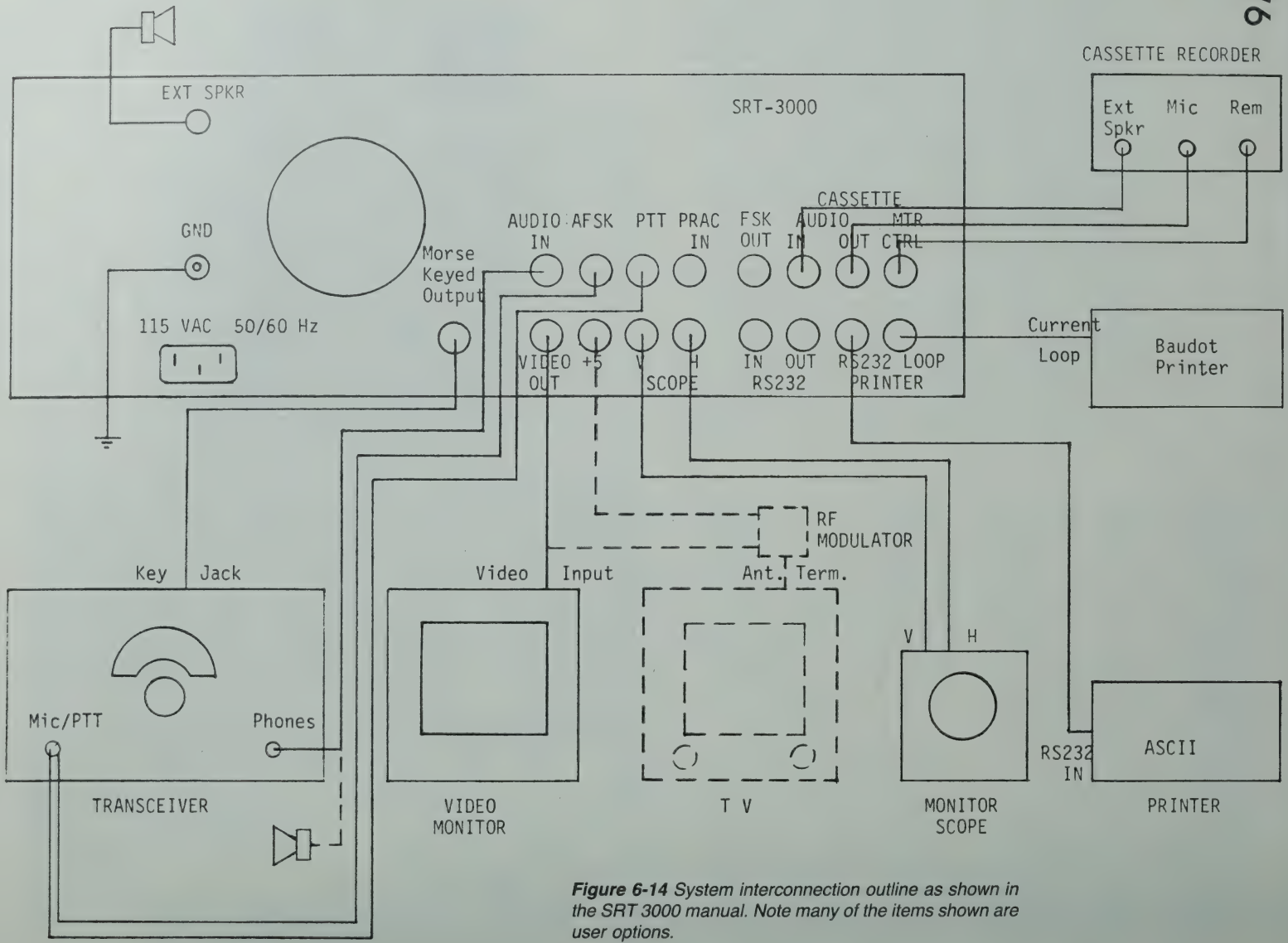


Figure 6-14 *System interconnection outline as shown in the SRT 3000 manual. Note many of the items shown are user options.*

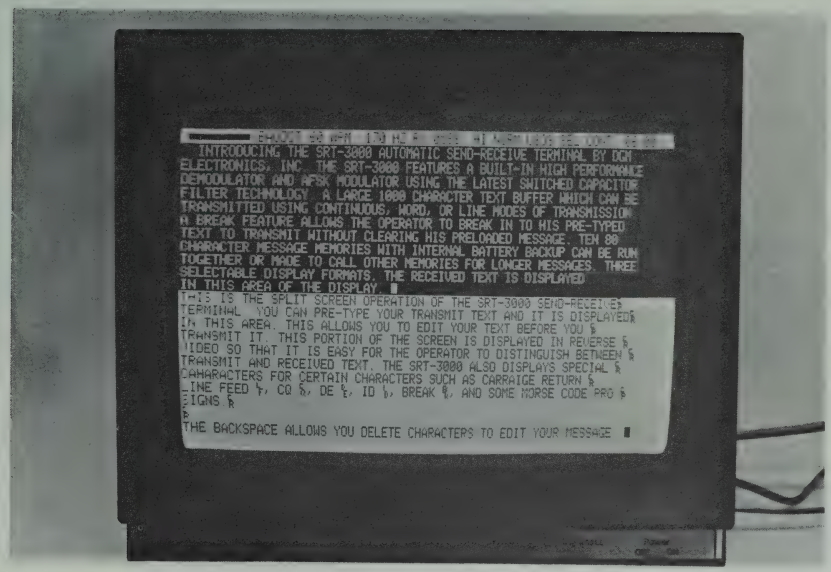

INTRODUCING THE SRT-3000 AUTOMATIC SEND-RECEIVE TERMINAL BY DGM
ELECTRONICS, INC. THE SRT-3000 FEATURES A BUILT-IN HIGH PERFORMANCE
DEMODULATOR AND AFSK MODULATOR USING THE LATEST SWITCHED CAPACITOR
FILTER TECHNOLOGY. A LARGE 1000 CHARACTER TEXT BUFFER WHICH CAN BE
TRANSMITTED USING CONTINUOUS, WORD, OR LINE MODES OF TRANSMISSION.
A BREAK FEATURE ALLOWS THE OPERATOR TO BREAK IN TO HIS PRE-TYPED
TEXT TO TRANSMIT WITHOUT CLEARING HIS PRELOADED MESSAGE. TEN 80
CHARACTER MESSAGE MEMORIES WITH INTERNAL BATTERY BACKUP CAN BE RUN
TOGETHER OR MADE TO CALL OTHER MEMORIES FOR LONGER MESSAGES. THREE
SELECTABLE DISPLAY FORMATS. THE RECEIVED TEXT IS DISPLAYED
IN THIS AREA OF THE DISPLAY.
THIS IS THE SPLIT SCREEN OPERATION OF THE SRT-3000 SEND-RECEIVE
TERMINAL. YOU CAN PRE-TYPE YOUR TRANSMIT TEXT AND IT IS DISPLAYED
IN THIS AREA. THIS ALLOWS YOU TO EDIT YOUR TEXT BEFORE YOU
TRANSMIT IT. THIS PORTION OF THE SCREEN IS DISPLAYED IN REVERSE
VIDEO SO THAT IT IS EASY FOR THE OPERATOR TO DISTINGUISH BETWEEN
TRANSMIT AND RECEIVED TEXT. THE SRT-3000 ALSO DISPLAYS SPECIAL
CHARACTERS FOR CERTAIN CHARACTERS SUCH AS CARRAIGE RETURN
LINE FEED
SIGNS
THE BACKSPACE ALLOWS YOU DELETE CHARACTERS TO EDIT YOUR MESSAGE

Figure 6-15 *One of the four selectable screen displays of the SRT 3000 is the split screen with received information at the top and transmit-ready text at the bottom. A closer look at the top status line is shown in the next figure.*

Looking over the SRT 3000 quite carefully and reviewing its overall capabilities, we find a very impressive unit. The system can be integrated into one's amateur setup quite easily, and any conventional video monitor may be used according to one's desired size of display.

THE DGM RT 1100 RECEIVE TERMINAL

This item, the RT 1100, is a receive-only unit which can be used with a conventional video monitor for RTTY monitoring on amateur and/or International Shortwave frequencies. Additionally, the RT 1100 can be mated with one's existing RTTY transmit terminal or DGM Electronics MKB 2000 keyboard (discussed in the next section of this chapter) when full transmit and receive capabilities are desired. The attractiveness of such a "stepped approach" is the beginning phase which uses a modern video display rather than a noisy teleprinter for monitoring.

The RT 1100 is a rather compact and attractive unit which copies RTTY at 60, 66, 75 and 100 words per minute, ASCII at 110 baud and Morse at 6 to 60 words per minute. Front panel switches **(Figure 6-17)** select parameters such as modes, speeds, shifts, etc. while an LED is employed for tuning indication (there are also rear jacks for oscilliscope X/Y display). Either manual or automatic speed tracking may be used for Morse copy. There are rear panel connections for a host of features **(See Figure 6-18),** including conventional 1 volt peak to peak video, a parallel ASCII printer output, etc. A regular TV set can also be used for display of RT 1100-processed information, either via an externally-added video modulator or by appropriate video amplifier tap/modifications. Some guidelines and examples of these techniques are included in the unit's manual. Tube sets with power transformers are usually the better candidates for "monitor modification."

Connecting the RT 1100 to one's setup involves only two or three wires: speaker output to RT 1100 input, video cable to monitor, and the printer interconnection (if used). There's a printer pinout diagram included in the manual, but doublechecking exact printer compatibility with DGM Electronics, Inc. shouldn't be overlooked.

The unit provides a video display of 16 lines with 32 characters per line and 2 pages of text. As received information scrolls off the page top, it is transferred to page 2 (which may be switch-recalled as desired). The unit also features a Morse practice mode, with a random code generator providing the characters. If desired, the RT 1100 can be parallel-connected to the station's key for CW monitoring. Either positive or negative polarity can be used, and wiring details are in the RT 1100 manual. At

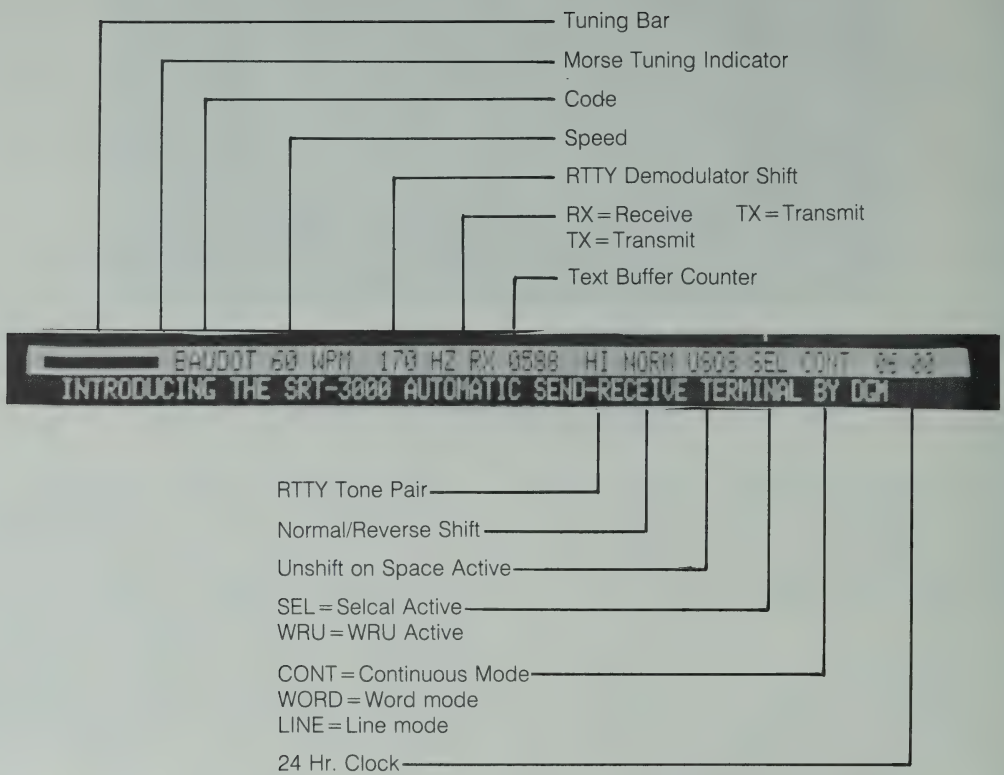

Tuning Bar
Morse Tuning Indicator
Code
Speed
RTTY Demodulator Shift
RX = Receive TX = Transmit
TX = Transmit
Text Buffer Counter
BAUDOT 60 WPM 170 HZ RX 0588 HI NORM U003 SEL CONT 00 00
INTRODUCING THE SRT-3000 AUTOMATIC SEND-RECEIVE TERMINAL BY DGM
RTTY Tone Pair
Normal/Reverse Shift
Unshift on Space Active
SEL = Selcal Active
WRU = WRU Active
CONT = Continuous Mode
WORD = Word mode
LINE = Line mode
24 Hr. Clock

Figure 6-16 *A status line is displayed on the top line of the screen. This line is always displayed on the first page to allow the operator to quickly determine the operating status of the SRT 3000. When a 36 character line length is selected, only the left half of the status line is displayed. The status line displays the following parameters.*

Figure 6-17 *The DGM Electronics RT 1100 receive only RTTY/ASCII/CW terminal employs switches for mode selections and a regular video monitor for display. Unit can be mated with a variety of terminals.*

Figure 6-18 *Rear view of the DGM RT 1100, revealing a group of popular RCA phono connectors and an RS232 socket.*

first glance, one might ask why there's no keyboard included. Simple. . .this is a receive only unit: the keyboard associated with dedicated terminals is for transmitting. Say this world of RTTY today is beginning to make sense?

THE DGM MKB 2000 KEYBOARD

The MKB 2000 is a mating keyboard which can be used with the previously described RT 1100 receive terminal. Alternatively, the unit can be used in conjuction with one's existing mechanical teleprinter for an electronic-transmit capable setup. Output of the RT 1100 proper is electronic keying for either positive or negative potentials up to 300 volts at 150 ma. This can be used to key a teleprinter's loop supply or to key the optional DGM AFSK generator (which provide 170 or 850 Hz shifts with 2125 Hz mark and 2295/2975 Hz space). As supplied, the keyboard is directly usable on a "plug into rig" basis for Morse transmit. Hence its designation "Morse Keyboard (2000)."

The MKB 2000 is a compact and self-contained unit with all connectors available on the rear panel **(See Figure 6-19 and 6-20).** As may be seen in the photo, all functions and selections are under keyboard control. Like the DGM SRT 3000, the MKB 2000 can also be set to transmit data via the character, word, or complete line mode.

Interconnecting the MKB 2000 with one's existing RTTY setup is relatively simple, but it will depend on the other items in use. If a mechanical teleprinter and an AFSK generator are already in use, the MKB 2000 can be wired to key the (previously used) loop supply. . .which then keys one's existing AFSK generator. If the optional DGM AFSK generator is installed, merely connect that "toned output" to the transmitter's mike input. Next, parallel-connect those tones to the RT 1100 for monitoring transmitted text (that measure isn't necessary, however, if your transceiver has an SSB monitor feature).

The MKB 2000 features a 500 character text buffer plus 10-40 character canned message buffers. An optional memory expander will boost this to 100 characters and 10-80 character buffers. A text "break" key is included, plus a repeat function which can be directed to any part of the stored information. A "normalizing" function is also included which provides a smooth output when keyboard use is irregular from erratic typing. The unit operates RTTY at 60, 66, 75, 100 and 132 words per minute, ASCII at 110 or 300 baud and CW at 1 to 199 words per minute. A cassette tape interface is included for recording and transmitting long messages. Finally, colored LED's on the unit's front indicate when buffers are half full and 99 percent full. **See Figure 6-19 and 6-20.**

The DGM MKB 2000 holds appeal both to amateurs making their first move into "electronic RTTY" and to amateurs preferring a "separate unit's" approach to a modern setup.

THE INFO-TECH 200/300 SYSTEM

An outstanding line of dedicated RTTY systems holding particular appeal to serious amateurs is manufactured by Info-Tech Electronic Equipment, 1633 Wisteria Court, Englewood, Florida 33533. Two of their more popular and less expensive units are the M-200F converter/terminal and the M-300C trimode keyboard. The two "stand alone" units combine with any conventional video monitor to form a complete RTTY/ASCII/CW setup, which can be used with most popular SSB transceivers. An optional

Figure 6-19 *Front view of the DGM MKB 2000, revealing a clean look and the fact selectable parameters are under keyboard control.*

Figure 6-20 *Rear view of the DGM MKB 2000. Note use of RCA phono and ¼ inch barrel sockets.*

computer-type printer or older teleprinter may be added to the system for hard copy, if desired.

The M-200F is a professional looking unit with performance to match **(See Figure 6-21).** Indeed, the unit is built for continuous operation and is used daily by government and military services. The M-200F employs dual microprocessors and copies Morse, Baudot and ASCII of various shifts and speeds. Dual front panel concentric controls permit easy tuning of speeds and tone shifts, while small toggle switches allow instant selection of other operating parameters. A multifunction display window provides LED indications of selected variable and on-frequency tuning.

Both video and printer outputs are provided on the M-200F. Video is 1.5 volts peak to peak, negative sync, 5 by 7 dot matrix, with white letters and black background. There are two printer outputs: a TTL level for RS232 at 110 or 300 baud for "home computer"-type printers and a 60 ma. loop keyer for older teleprinters. All speed conversions are handled by the M-200F for interfacing these units. Oscilliscope outputs are also included on the rear connector for "crosshair" tuning displays.

Interconnection and setup of the Info-Tech 200/300 system is relatively straightforward and troublefree. As shown in **(Figure 6-22),** the demodulator unit connects to an amateur HF transceiver via conventional RCA phono plugs and sockets. The video monitor connects via a PL259. Hard copy can be accomplished by keying a teleprinter's loop supply or rigging an interface cable for a home computer-type printer. Info-Tech Company may be able to supply details and/or cables for interfacing specific printers. An autostart keying line is also provided on the M-200F. This may be used for enabling other items such as the M-300 keyboard or a tape recorder. Since the model 300 keyboard is a self-contained, "stand alone" unit for both creating and transmitting RTTY/ASCII/CW, its AFSK output is merely directed to the HF transceiver's microphone input. A parallel audio line can be directed to the M-200F demodulator for monitoring, if desired, or the transceiver's SSB monitor function may be used. There's also an "auxiliary" connnection on both the keyboard unit and the demodulator for direct interconnection and monitoring.

The Info-Tech 200/300 system will operate Morse, Baudot and ASCII in an effective manner. Morse receive speeds are 5 to 105 words per minute with automatic speed tracking. Baudot rates are 60, 67, 75, 100 and 132 words per minute. As supplied, the M-200F will decode 110 baud ASCII: an optional demodulator with a wider bandpass is required for 300 baud reception.

Filters are included for both mark and space frequencies and selectable shifts 170, 425 or 850 Hz are pro-

Figure 6-21 *Performing in a manner comparable to its professional appearance, the Info-Tech M-200F employs quality construction throughout.*

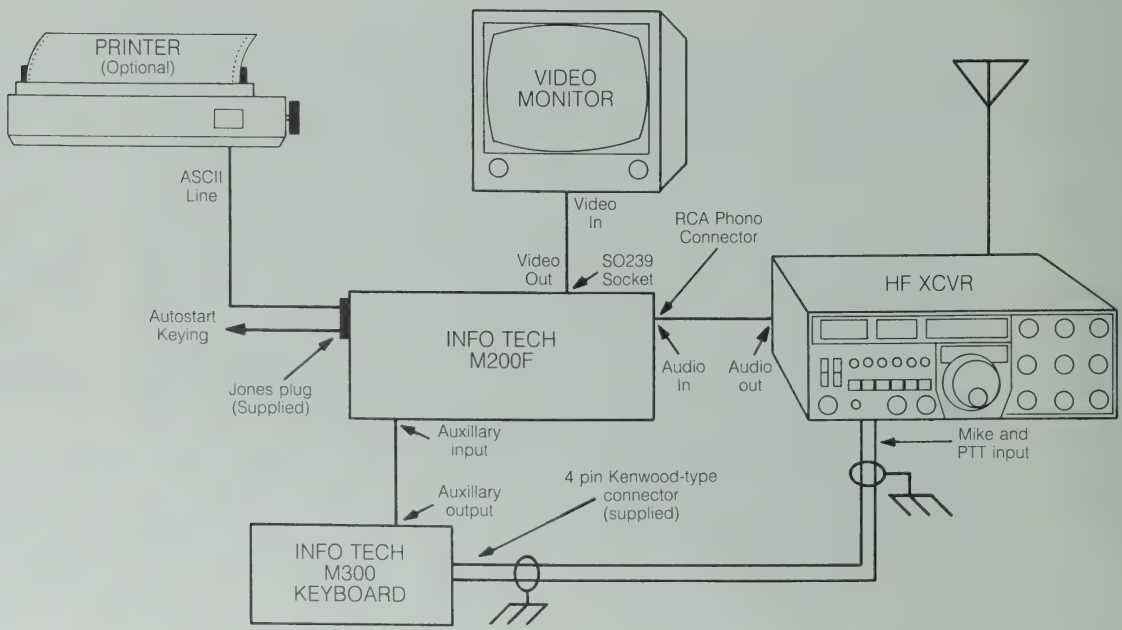


Figure 6-22 *Interconnecting layout for the Info-Tech M-200F and M-300 RTTY system.*

Figure 6-23 *The Info Tech model 300C self-contained RTTY/ASCII/CW keyboard. Unit can be used with M-200 or M-600 demodulator for a top quality system.*

vided. There's also a tunable space filter (2225 to 2800 Hz) for copying non-standard shifts. The front panel mark and space LED's plus a 10 step bar-graph indicator make signal tuning a snap.

Among the M-200F's special features are front panel push buttons for clearing the video display's screen, resetting the main microprocessor, an automatic threshold control for smooth copy under marginal conditions, variable CW selectivity, normal/reverse signal phasing, and four video display formats. Switch-selected displays may be 32 or 72 characters per line, and either 16 or 25 lines of print.

The model 300C keyboard generates Morse at 4 to 125 wpm, RTTY at 60, 67, 75, 100 or 132 wpm and ASCII at 110 or 300 baud. Both FSK activation (up to 200 volts at 100 ma.) and AFSK outputs (0 to 2.5 volts peak to peak) are provided. The transmitter-keying line will handle up to 30 volts at 250 ma. **(See Figure 6-23).**

There are 11 programmable or "canned" message memories in the keyboard unit, each holding a maximum of 120 characters. Soft partitioning is used between memory locations, allowing them to "overflow" and "stack" in subsequent memories as desired. It is thus possible to arrange 6-120 character memories and 1-600 character memory. . .or 1 large 1320 character message. A "buffer full" LED illuminates when each "canned message" area is filled. Also included in the keyboard unit is a 700 character type-ahead buffer which can be loaded during receive periods. All of the "frills" found on "top-of-the-line" units (such as a CQ button, auto CR/LF, RY and Quick Brown Fox messages, RTTY "diddle", etc.) are, naturally, included in the 300C keyboard.

Nearly all of the unit's functions are under keyboard control. Mode and speed changes, buffer loading and recalling, etc. thus require two or three keystrokes for activation. There's even a transmitter-enable function which can energize the transmitter when one begins typing on the keyboard. Clever!

All aspects considered, the Info-Tech 200/300 system is an ideal unit for the RTTY enthusiast. The system's easy interconnections and flexible capabilities are a superb combination.

THE INFO-TECH M-600A/300 SYSTEM

This quite complete and professional setup consists of Info-Tech's multimode decoder, the M-600A, and the versatile Model 300 "stand alone" keyboard unit. The M-600A will decode Morse, Baudot and ASCII plus TOR (such as SITOR or AMTOR) in either ARQ or FEC modes. The unit can also be used for decoding any combina-

tion of bit-inverted codes. . .an RTTY monitor's "dream unit." **(See Figure 6-24).** The front panel key pad controls selection of modes, speeds, demodulators, etc. The 2K byte printer buffer provides information speed conversions, and four video displays are available: 16 or 25 lines and 36 to 72 characters per line. A bottom line status indicator provides video display of mode, speed, etc. Circuit wise, the M-600A uses a combination of active filters and phase locked loops to track speeds from 5 words per minute (CW) through 300, 600 and 1200 baud (ASCII). Both fixed shifts (170, 425, 850 Hz) and continuous tuning of the space filter permit copying non-standard signals. A quite functional bar-graph tuning indicator plus mark and space LEDs provide easy tuning. Additional LEDs indicate autostart, buffer full, Morse lock, high baud tuning, limiting and signal lock. All aspects considered, it's a very complete unit!

Interconnection and setup of the M-600A decoder and Model 300 keyboard is easily accomplished within a few minutes time **(See Figure 6-25).** Received audio tones are directed to the M-600A's input while video output is directed to a conventional CCTV monitor. Optional hard copy printing may be accomplished by keying the loop supply of an older model teleprinter, or by interfacing one of the newer model home computer-type printers. A Centronics compatible parallel printer output is optional. As mentioned in the Info-Tech 200/300 systems, the Model 300 keyboard is fully self-contained and operates independent of the demodulator unit.

The M-600A copies Morse speeds ranging from 5 to 60 words per minute. Baudot rates are 60, 67, 75, 100 and 132 words per minute. Progressing in capabilities, the M-600A will decode 110, 150, 300, 600 and 1200 baud: an attractive feature for packet radio and high density data innovators.

In addition to the M-600A's many features outlined previously, several other capabilities are provided for serious RTTY enthusiasts. These include Multiple Scroll Inhibit to prevent excessive use of paper during hard copy, screen and paper printing identical quantities of text, Autostart and Selcal, plus a wide range of keypad-controlled functions. The Info-Tech 300C keyboard was reviewed with the previously described M-200/300C system.

Figure 6-24 *Info Tech's top of the line M-600A demodulator copies RTTY, Morse, ASCII and AMTOR signals in a very professional manner. Full details are presented in text.*

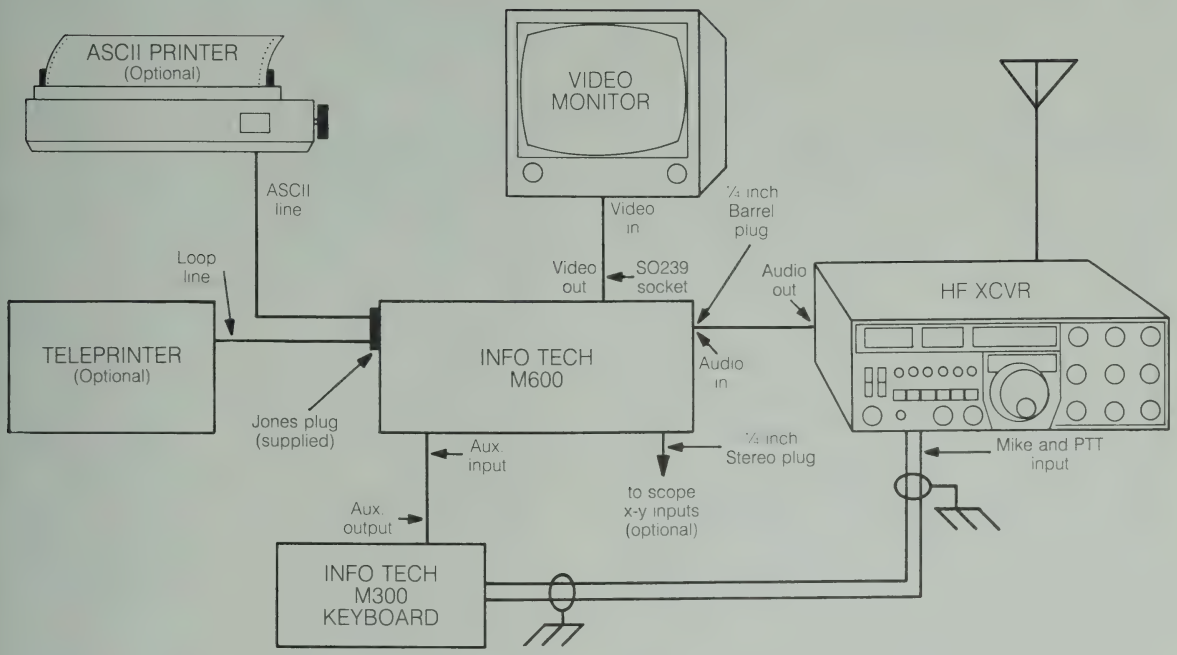


Figure 6-25 *Interconnection layout for the "no compromise" Info Tech M-600A/300 RTTY/ASCII/CW system. This professional system is used daily by both commercial and amateur services.*

CHAPTER 7

MINI RTTY SYSTEMS

The exciting world of RTTY today is quite diverse in both operating trends and in utilized equipment. Indeed there is something within this area for everyone. . .be it primarily monitoring printed information transmitted on International shortwave frequencies or exclusively operating RTTY on the amateur HF or VHF bands. Likewise, the available equipment for RTTY assumes various forms. . . from the mechanical marvels of yesteryear or today's popular computer-based setups to dedicated all-electronic terminals or the most recently introduced units which we'll simply call "mini RTTY systems." The latter items are the topic of this chapter: Those small and self contained units which can provide various RTTY, ASCII and CW functions without the use of popular additional items such as video monitors, a home computer, printers, etc. The interesting and unique aspect of their operation is supreme flexabilitiy to match any setup. . .fixed, portable or mobile!

There are a number of times when an amateur would like the capability of reading RTTY and/or ASCII transmissions but the aspect of setting up a teleprinter or video display-related system isn't particularly attractive. Possibly that activity is too occasional or sporadic. Possibly that amateur is more portable than fixed station oriented, or possibly a compact "second system" is attractive for vacation. . .or even mobile operating. Whatever the case, there's a definite vacancy that can be perfectly filled by one of today's mini RTTY units. There are essentially two categories of these "stand alone" units: receive only, and both transmit and receive-capable units. The receive only units, or "RTTY readers" as they are affectionately known, are little gems boasting significant improvements over their ancestors of several years ago. Today's units require only miniscule audio input levels while internal filter circuits provide a certain amount of interference reduction. Likewise, the small overall size of these units permits their placement in any available operating desk area. If you've somehow been missed by the great and informative RTTY reader bird, you may now be asking exactly how these units work. Let's thus pause briefly and ponder that situation.

RTTY readers resemble a full featured receive only terminal in a very small package, their size often providing a flexibility unobtainable with larger units. Inside these small boxes, there are complete RTTY and CW demodulators plus microprocessor-type circuitry and information buffers for data conversions and an LED or fluorescent readout. It is thus feasible, for example, to use an RTTY reader primarily as a portable "stand alone" unit and secondarily as a demodulator unit "in front" of a suitably programmed home computer. Some RTTY readers provide output connectors for that function while other units may require adding a demodulator tap-off and output jack. Incoming RTTY, ASCII or CW audio tones acquired from the earphone or speaker connections of a shortwave or amateur receiver are directed to the unit's input. Following signal amplifying and limiting, appropriate frequency filters separate mark/space signals. That demodulated information is then directed to specially manufactured integrated circuits which convert each character block into a set of readout tube-activating voltages. As those segment-activating voltages for each character are applied to each individual readout tube or LED, the information becomes visible. Since information is being received on a character-by-character basis (and thus continuously changing), character information/segment activating voltages must be continuously "clocked" from buffer to buffer for providing a "time square" type of moving display. As we watch that display, incoming messages thus move from right to left at a rate primarily determined by the speed of the transmitting station.

The most obvious uses for RTTY readers are monitoring various RTTY and ASCII transmissions and bulletins. However, there are several additional capabilities which shouldn't be overlooked. These units provide a unique means for Morse code assistance both in the classroom and on the air. When used in conjunction with W1AW on-the-air code practice, for example, the reader provides both aural and visual instruction. This ability to look up and see the unrecognized character or word has proven quite useful in increasing copy speed. Likewise, the previous capability could be integrated into Morse class use

to provide silent instruction to "slower" members while "faster" members proceed without aural interruptions. RTTY/ASCII/CW readers are also ideal for monitoring ones on-the-air "fist" and for visually telling non-amateur visitors in the shack what the operator is actually transmitting to another station. Yet another use for RTTY readers is the capability of monitoring the rapidly increasing trend of super speed CW communications. These 60 plus word per minute activities have been spawned by today's microprocessor based systems and CW keyboards, and their future looks quite promising. Using an RTTY reader to initially consider joining that activity is a very logical idea.

The second category of mini RTTY systems encompasses the self contained RTTY/ASCII/CW converter and display units recently introduced in the amateur radio world. The basic difference between these units and the previously described receive-only "readers" is the ability to both transmit and receive RTTY and ASCII without the use of a keyboard or video monitor. LED's or fluorescent tube displays are used for information readout while a hand key or electronic keyer is used in place of the usual keyboard. That's right. . .RTTY directly from a hand key. If you're one of the many radio amateurs who have more trouble learning to type than sending reasonable clean and fast CW, hand key RTTY may be your perfect solution. These small mini RTTY units are also ideal for amateurs with limited operating space or for portable operations. In fact, the units can also be operated mobile! Visualize the look on a distant amateur's face when you sign "slant mobile" and humorously mention you're trying to get a Model 32 teleprinter in the front seat! Those discouraging moments when one must leave RTTY gear behind during a brief trip to the beach or mountains have now been replaced by a unit smaller that an HF transceiver. . .a "take it with you" item which also eliminates disassembling any in-station RTTY gear. (There's no law, other than personal economics, that prevents one from having two independent RTTY systems).

A "second form" of transmit and receive-capable mini system is the "full blown" unit which can be used independently or integrated with other station items for true full featured capabilities. In addition to providing stand alone RTTY and ASCII communications capabilities via this internal display and a hand key, these items also perform code and speed conversions for using older teleprinters at faster speeds and for ASCII communications. Likewise, a home computer's typical ASCII output could be directed to one of these units for producing RTTY or CW outputs at whatever speed desired. Those may seem like some rather phenomenal capabilities, but multimode RTTY/ASCII/CW converter units are rather phenomenal items.

RTTY/ASCII/CW converter units employ the same basic circuit concepts used in RTTY readers, plus they also include CW to RTTY translation units, additional buffers, and AFSK generator circuits. The more sophisticated multimode converter units also require more buffers, plus microprocessor control sections for necessary information conversions.

A question has been recently raised concerning the overall feasibility of using a hand key or electronic keyer along with a mode converter for RTTY. Could the average radio amateur send Morse clean enough to be properly interpreted by such a machine, and would the speed be fast enough to hold the contacted amateur's interest? The answer is fortunately yes, provided an electronic keyer (with its associated self completing dot/dash capabilties, proper spacings, etc.) is used and the keying speed is over 15 or possibly 20 words per minute. Reading many on-the-air RTTY communications, we find numerous radio amateurs are not proficient typists. . .typing rather slowly and making an acceptable number of mistakes (reassuring, eh?). Similar, or in some cases, better results can be obtained by any normally proficient amateur using a hand key and RTTY converter unit.

This might also be an opportune time to clarify one other fact of RTTY life: speeds of machines versus speeds employed in typed communications. A teleprinter operating at 60 words per minute doesn't require an incoming message be keyboard (or handkey) entered at 60 words per minute. The machine's "innards" merely clock data or mechanically function at that speed when information is received. A one word per minute transmission, for example, merely sets the (60 wpm unit) unit idling most of the time with brief interruptions (bam!) for a rapid letter print. . .then idles, and then another key prints (bam!), etc. Likewise, 100 word per minute modes are not directly compatible with 60 word per minute modes (and vice versa) although each may be used for conveying messages typed at only 10 or 15 words per minute. RTTY converters and mini RTTY systems thus have a very useful and logical place in today's amateur setup, whether they are fixed, portable or mobile (the latter, we trust, being operated while parked or properly co-piloted!).

The units discussed on the following pages of this chapter represent a cross section of presently available

commercial items. As with the previous chapter, we again remind you discussion of these units and possible preclusion of other commercial units doesn't signify endorsement or rejection of any unit over another. Utilizing working units as examples of mini RTTY systems is simply the best way to learn how things operate.

THE KANTRONICS MINI READER

Bearing a striking resemblance to today's popular hand held calculators, the Kantonics Mini Reader can be slipped in a coat pocket or large shirt pocket and used in a variety of ways. The unit is equally at home in fixed, portable or mobile setups: An adjustable tilt bracket and fluorescent readout tubes providing physical adaptability while conventional ⅛ inch barrel sockets are used for audio and key connections. The reader proper may be powered from an external DC source of 8 to 18 volts, and a mating "wall adapter" supply is furnished with the unit. The only connection required involves paralleling the supplied cable with the station's speaker (and parallel connecting with the station's key if CW transmit monitoring is also desired). **(See Figure 7-1).**

Figure 7-1 *Front view of the Kantronics Mini Reader. This pocket sized unit copies Baudot, ASCII and Morse.*

The Mini Reader employs a 10 digit "Time Square" type running display and an LED tuning indicator which results in relatively easy and comfortable operations. There are front panel push buttons for selection of RTTY, ASCII and Morse operation, plus the selectable time function allows the unit to serve "double duty" as a 24 hour station clock. There are left side jacks for DC power (from supply), audio input (from code practice oscillator, AFSK generator, receiver, etc). key (for reading one's sending) and audio output (which "normals" through the audio input connection). The key jack also serves as a RTTY demodulator output providing high impedance TTL signals (plus 5 volts and 0 volts) which may be used with a suitably programmed home computer for RTTY/ASCII/CW reading.

The Mini Reader features an internal tone demodulator at 750 Hz for CW and another demodulator for RTTY space signals at 2295 Hz. Reception of any shift (170, 425, 850 Hz, etc.) is thus possible by tuning the associated receiver until space signals are 2295 Hz. A narrowband filter is employed to reduce adjacent channel interference. Microprocessor control within the reader provides automatic selection of 60, 67, 75 and 100 words per minute RTTY and 110 or 300 baud ASCII (300 baud is too fast for reading unless the sending party types slowly). The unit will also track Morse speeds of 3 to 80 words per minute automatically, although any mode continuously running at 50 words per minute or faster may require speed reading individuals. Letters move rather swiftly across a 10 digit display!

The unit is quite useful for monitoring relatively accurate CW "fists," and can prove its worth for code practice sessions. This includes both on-the-air receptions (such as W1AW) and classroom applications. Additionally, the unit can be used for checking code speeds and monitoring students progress in learning.

Using the Mini Reader to copy RTTY, ASCII, or Morse signals usually requires a few minutes "period of adjustment." Since the display is somewhat limited, sentences must be read in portions and assembled mentally. This isn't difficult; indeed, most of us copy CW in that fashion today. Readers, however have a tendency to let us forget that fact when printed words begin appearing on the display. Reading Morse code also requires understanding or realizing that not everyone sends "perfect" CW. Characters will inevitably become scrambled or lost when a poor "fist" or "swing" is being received. The overall capabilities

Figure 7-2 *The AEA MBA-RO is a superb performing RTTY/ASCII/CW reader hosting internal filters, tuning indicator and a 32 digit readout.*

afforded by this Kantronics Mini Reader, however, are quite impressive. The unit serves well for copying RTTY bulletins and news broadcasts, especially when displayed information is simply read aurally into a cassette recorder and then played back for "full story reading."

THE AEA MBA-RO READER

A rather sophisticated yet compact Morse, Baudot and ASCII reader is manufactured by Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood, Washington 98036. Appropriately designated MBA-RO (reader only), this unit features both mark and space demodulators plus selectable bandwidth filters and a 32 digit "times square" moving display. There's also a dual LED tuning indicator plus a threshold adjustment which aids in reducing band noise interference. The unit's display uses blue fluorescent tubes, and a Morse speed indicator (which utilizes 2 of the display's tubes) may be switched on or off as desired. Right side connectors are provided for receiver audio output, "normal through" to the station's speaker, hand key input (which may be parallel-connected with the station's transmitter), and a power jack (12 volts DC at 600 ma. required). **(See Figure 7-2).** Suitable "wall adapters" are available from a number of suppliers, including AEA. The unit copies Morse code up to 80 words per minute with good consistency, provided the transmitting amateur's "fist" is reasonably good. A couple of seconds time is required for normalizing and to achieve accurate speed tracking.

During RTTY and ASCII signal reception, the MBA RO performs like a true winner. The dual demodulators provide good adjacent channel rejection while the 32 character display bears a similarity to reading a narrow column newspaper article on a line by line basis. The unit copies RTTY at 60, 67, 75 and 100 words per minute, ASCII at 110 or 300 baud and Morse up to 80+ words per minute. Speed selection is controlled by a front panel switch. Filters within the MBA-RO are set for standard amateur 170 Hz shifts, however other shifts may be copied by offset-tuning the associate receiver while the reader's filter switch is placed in the CW position. (In other words, using only the RTTY space filter and demodulator).

The MBA-RO is quite useful for improving one's Morse code copying ability (assuming, naturally, the monitored CW isn't being derived from a sloppy "fist"). Indeed, there should be at least one of these units in every amateur radio club's classroom and each F.C.C. examining room. In addition to the unit's training use of displaying those "slightly too fast" characters or words, the accurate speed readout provides tangible evidence of CW proficiency to unbiased examiners. The unit also holds creditable merit

for in-shack use. Assuming the station's transceiver employs a CW sidetone, both received and transmitted information can be displayed and read by non-amateur visitors. The only hitch here involves acquiring good Morse code. . .from both of the communicating amateurs. If more of these units were used by CW operators, on-the-air Morse code would surely become more readable! Fortunately, increasing numbers of amateurs are using electronic keyers and thus producing better quality transmissions.

Some of the less obvious features of the AEA MBA-RO are its quality internal construction and complete metal cabinet. RF immunity at high power levels is very good, and overall, the unit is extremely rugged.

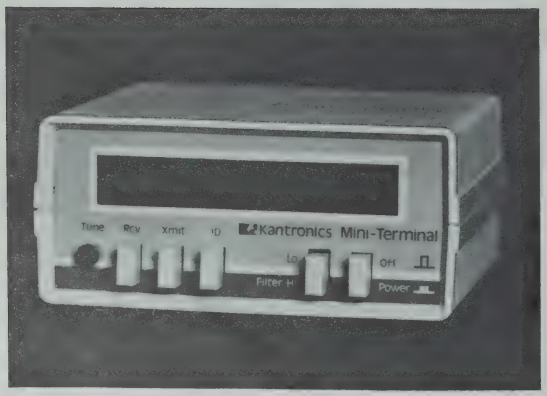


Figure 7-3 *The Kantronics Mini Terminal is a complete RTTY system in a single compact box. Incoming information is shown on display while hand keyed Morse is converted to RTTY.*

A CLOSER LOOK AT HAND KEY-RTTY

Are you one of the many amateurs that would like to join the action of RTTY today but simply don't have the "knack" for typing? Possibly you're involved in a rather fast lifestyle which doesn't allow time for learning how to use the "green keys." Realizing those facts, at least two commercial manufacturers have developed "stand alone" units which can be mated with a hand key for complete RTTY communications. RTTY communications with a hand key and multidigit RTTY reader is a fascinating change of pace which must be experienced to be truly appreciated. A small terminal, key and HF transceiver comprise the setup which is flexible enough to suit anyone's space or mobility requirements, and it provides an opening door for following bulletins transmiited via RTTY. Additionally, these mini RTTY systems are useful for joining in the popular electronic mailboxing techniques of others and for sending and receiving satellite-mailboxed messages (in other words, mini RTTY systems themselves may not include their own electronic mailbox but they can be used to access remote "mailboxes"). The following items reviewed in this chapter feature the hand key/RTTY concept and are thus presented for your knowledge and information.

THE KANTRONICS MINI TERMINAL

Designed expressly for limited space activities and hand key operation of RTTY, the Kantronics Mini Terminal is today's operation of self-contained RTTY system. The tiny unit may be powered from any 8 to 18 volt DC at 250 ma. source, giving appeal for fixed, portable or mobile operations. **(See Figure 7-3).** Incoming information is displayed on a 10 digit fluorescent readout, and an internal AFSK generator provides standard 170 Hz shifted-2125/2295 Hz tones for modulating a transmitter via its mike input. A front panel LED is used for tuning indications, while other switches select CW ID (2175 Hz) high or low frequency filters (for copying RTTY or CW), manually or automatic switching of transmit/receive speeds. There's also rear connectors provided for keying the loop supply of an older teleprinter or newer Centronics-type home computer printer. The Mini Terminal is enclosed in a tan plastic cabinet measuring 2½ by 5 by 2¼ inches. The blue-green readout is easily visible without being overbearingly bright. The unit's special features include automatic USOS and CRLF.

A station interconnection guide for the Mini Terminal is shown in **(Figure 7-4).** The station's speaker is "tapped" for an audio signal into the terminal (conventional ⅛ inch barrel plugs and jacks are provided for this function), while the unit's AFSK output and push-to-talk keying lines

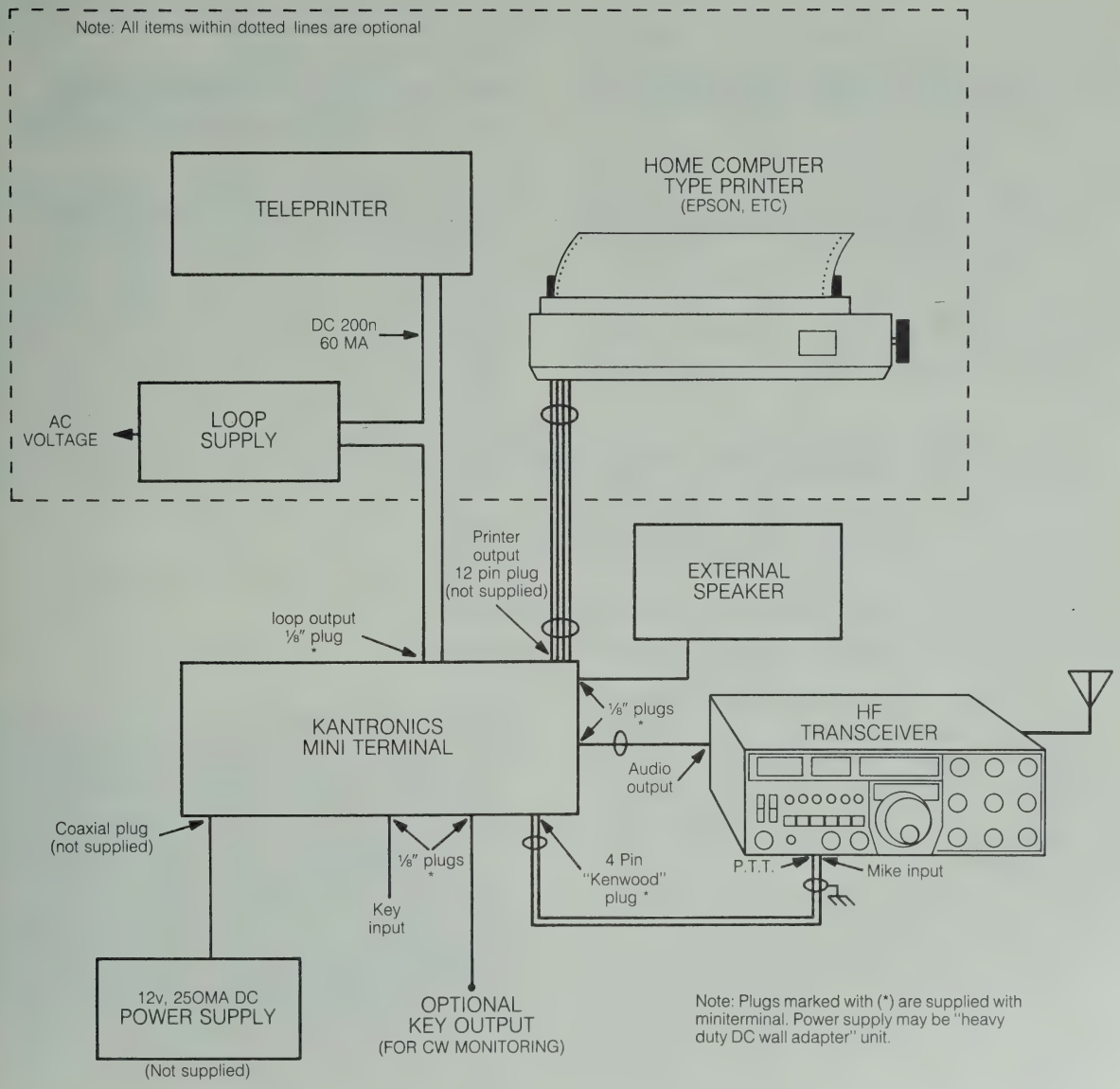


Figure 7-4 *Interconnecting layout for operation of the Kantronics Mini Terminal for "stand alone" RTTY.*

eminate from a 4 pin Kenwood-type mike connector. There are rear connectors for hand key input and output: the latter situated for "normal through" wiring provides visual monitoring of Morse transmissions. The printers shown are optional units for hard copy of received information. Notice that when an older model teleprinter is employed, an external loop supply capable of 20 or 60 ma. of current (according to the specifically utilized teleprinter) is required. The Mini Terminal itself does not provide loop voltage; it merely keys that voltage. We might also add that popular "wall adapter" DC supplies providing typical outputs of 12 to 16 volts at 100 to 300 ma. can't be used as loop supplies. Although parameters usually specifying these supplies are in ma., the necessary voltages range from 30 to 90 volts DC.

The Mini Terminal Centronics-compatible printer output may possibly be used with several of the popular home computer printers, but acquiring enough information for suitably wiring and cabling those units is a precarious situation. Possibly Kantronics can offer assistance in that area. Once the previously mentioned connections have been made, one only need adjust received audio and the AFSK modulating level and RTTY or ASCII communications can begin.

Although the Mini Terminal's AFSK generator is factory set for transmitting only 170 Hz shifted RTTY or ASCII, any shift may be read by the unit. This is accomplished by offset tuning the receiver so that RTTY space signals are reproduced at 2295 Hz: a simple RIT action. Likewise, RTTY speeds of 60, 67, 75 and 100 words per minute are step-selected by the front panel "receive" switch. CW ID during RTTY operation may be accomplished manually or by sending AR on the hand key, and following with the CW message. Manual insertion of CRLF (carriage return and line feed) is also possible by keying AS when desired.

The Mini Terminal does a creditable job of serving as an RTTY or ASCII terminal, but it does require a fairly accurate Morse code input. As the saying goes, "garbage in equals garbage out." If your CW fist is poor, your RTTY transmissions will be horrendous. We highly suggest using an electronic keyer. If your fist is still poor with a keyer, there's one final alternative: a Morse keyboard (somehow this seems like where we began this saga).

One final point of the Mini Terminal involves using the unit as a Morse reader and transmitted information monitor (a highly appreciated feature for non-amateur visitors). If you're using a transceiver with built-in sidetone, merely shift the sidetone's frequency to pass through the terminal's narrowband filter (250 Hz wide; 750 Hz center frequency). If your rig doesn't include a sidetone, simply connect the hand key to "normal through" the Mini Terminal. This unit is an impressive little package suitable for many operations, consequently we expect to see it soon gain increased popularity.

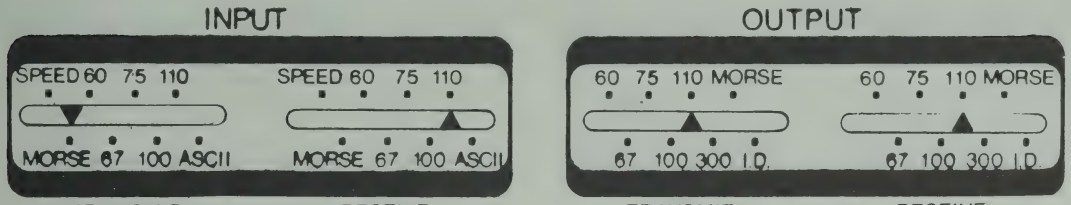
THE AEA MBA-RC CONVERTER SYSTEM

Boasting an extensive list of features and capabilities that might outperform some of today's home computer or microprocessor controlled RTTY/ASCII/CW setups, the AEA MBA-RC is a small yet sophisticated package of modern electronics technology. As a means of simplifying descriptions of this super unit, we will break its functions into two categories. Primarily it read Morse, Baudot and ASCII units internal 32 digit fluorescent display. Additionally, it will permit you to transmit Morse, Baudot or ASCII via a hand key or electronic keyer. This is only a "tip of the iceberg," however, as its secondary functions include crossmode and crosspeed conversions. Using

Figure 7-5 *Front view of the AEA MBA-RC, showing convenient layout of controls and the 32 digit readout. Mode selectors and tuning indicators are in lower area.*

CONDITION:

Your Station: Working Morse Code-using 32 character display
Other Station: Working 110 Baud ASCII

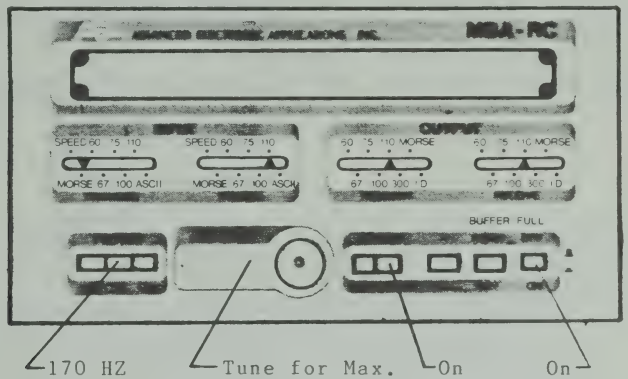


TRANSMIT
You are inputting Morse to the MBA-RC from a key, keyer or keyboard.

RECEIVE
You are reading 110 Baud ASCII on the 32 character display.

TRANSMIT
The MBA-RC is outputting 110 Baud ASCII, AFSK to your Xmtr.

RECEIVE
You are reading from display so use 110 Baud ASCII position so buffer will not overflow.



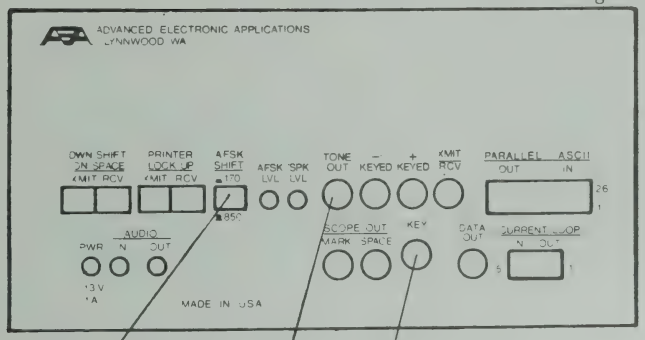
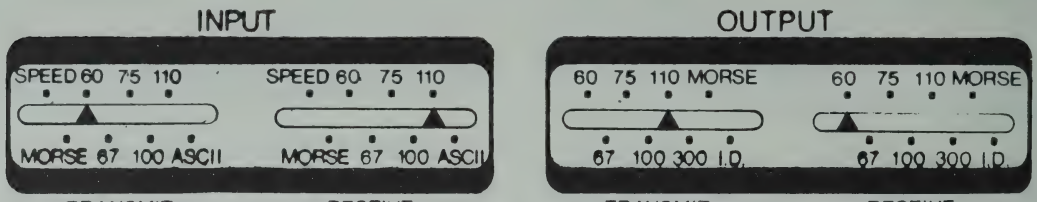


Figure 7-6 *Operating example of AEA MBA-RC.*

CONDITION:

Your Station: Working Baudot 60 WPM-using Model 15,19,26,etc.
Other Station: Working ASCII 110 Baud.

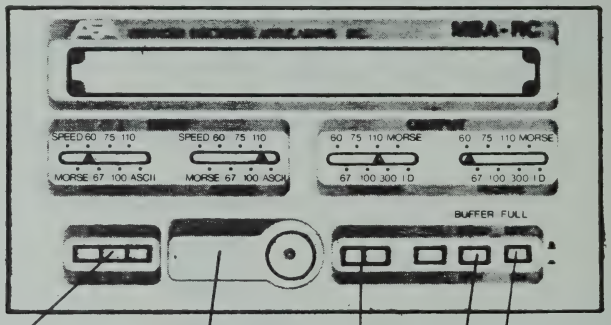


TRANSMIT — Inputting Baudot at 60WPM to MBA-RC from keyboard via the loop imput port.

RECEIVE — Receiving 110 Baud from your receiver. (audio)

TRANSMIT — The MBA-RC is outputting 110 Baud AFSK to your Xmtr.

RECEIVE — You are getting hard copy of the receive signal on your Baudot printer.



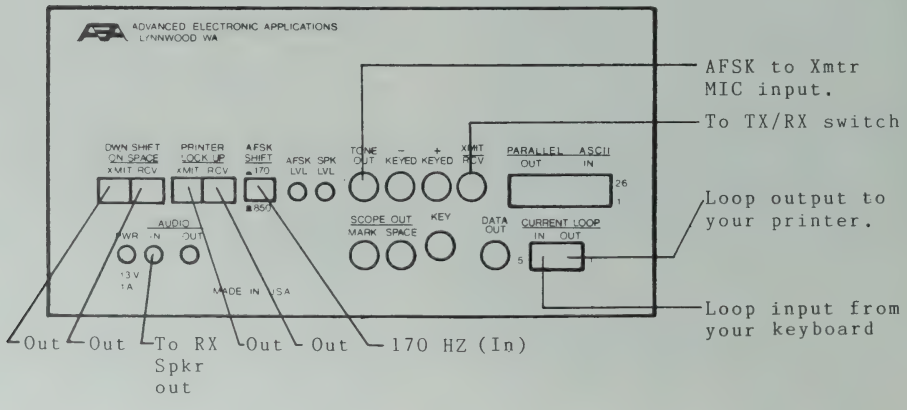


Figure 7-7 *Operating example of AEA MBA-RC.*

the MBA-RC with an older model teleprinter at 60 words per minute, for example, permit communicating with 100 words per minute machines, ASCII at 110 or 30 baud, or CW stations operating any speed from 3 to 80 words per minute. In the latter case, your keyboard typing is converted to Morse while incoming Morse is displayed on the fluorescent readout or hard copied on the teleprinter. The MBA-RC can also be used with a home computer for RTTY and Morse operations. In this case, the MBA-RC converts the computer's 110 or 300 baud ASCII to Baudot or Morse at the speed you select. Another feature of this unit is operating high speed CW with either a hand key or computer terminal. In fact, any cross operation one can visualize is included in this unit's capabilities!

Looking at the MBA-RC's front panel **(Figure 7-5),** there are four mode selectors below the display: 2 for input and 2 for output. The left switch selects the input medium which will be used for driving the transmitter, and the right switch selects the medium being acquired from the receiver. Looking at the output selectors, the left switch selects the desired output which will be fed from the MBA-RC to the transmitter, and the right switch selects the MBA-RC's display rate or printer/computer output rate. If the previous explanations seem confusing, study the crossmode conversion examples shown in **(Figure 7-6 and 7-7).** In one case, the MBA-RC is being used "Field Day" style to provide hand key-Morse to home computer ASCII communications (or maybe for writing articles on your home computer with a hand key rather thay a keyboard!). In the other example, the MBA-RC is being used to provide communications capabilities between an older model teleprinter and a home computer operating at 110 baud ASCII.

The lower front panel controls select RTTY/ASCII shifts, CW or RTTY tuning, automatic or manual CRLF, RTTY CW ID and internal buffer indicators. The MBA-RC will operate Morse at 2 to 80-plus words per minute, RTTY at 60, 67, 75 and 100 words per minute and ASCII at 110 baud. The unit will transmit 170 Hz or 850 Hz shifts (rear panel selectable); it will receive any shift from 100 Hz to 1000 Hz. Dual filters and demodulators are included, along with a bar-graph tuning indicator. There's a 1024 character receive buffer and a 40 character ID transmit buffer. Looking at the unit's rear **(Figure 7-8),**

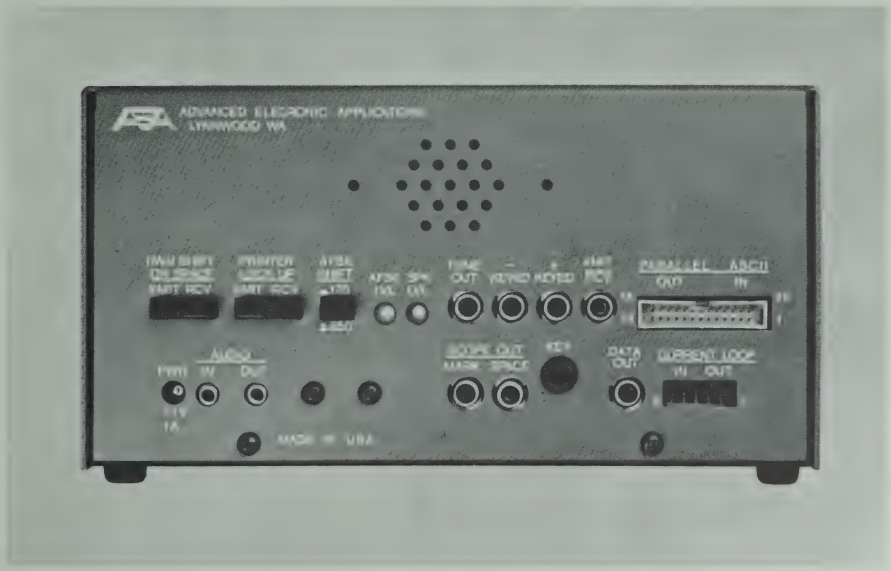


Figure 7-8 *Rear panel of the MBA-RC reveals less often used switches, numerous well-labeled connectors, printer socket and speaker. Full details are presented in text.*

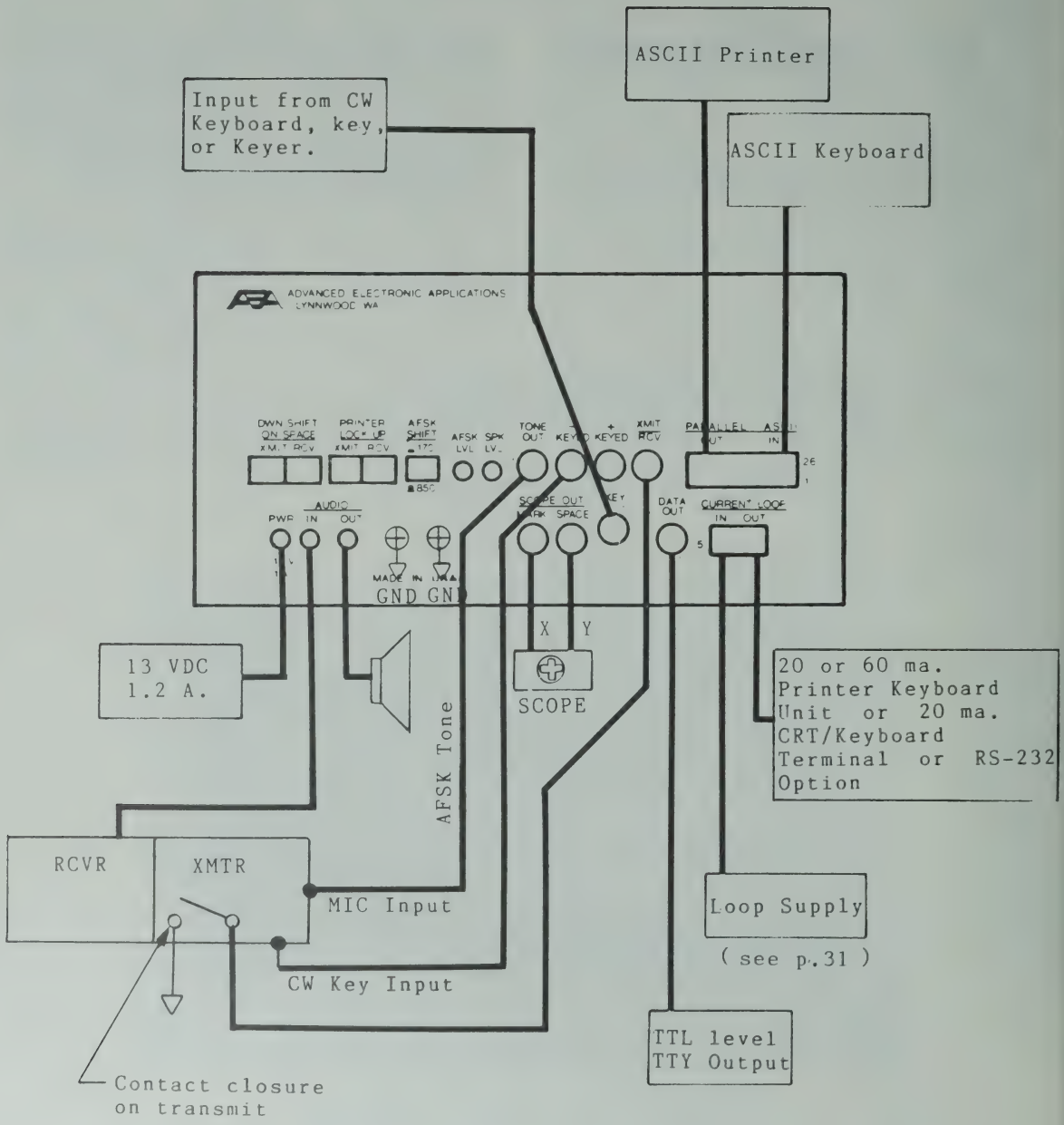


Figure 7-9 *Rear panel connections and block diagram of RTTY system with AEA MBA-RC.*

there's selectable USOS, printer lockout to prevent continuous hard copy, audio in/AFSK out adjustments, positive or negative transmitter keying, AFSK out, 'scope X-Y outputs, teleprinter loop keying (either 20 or 60 ma. loops acceptable), ASCII input (from computer), ASCII output (to computer), a serial data line, plus a rear mounted monitor speaker. The unit requires 12 to 15 volts at 1.2 amperes for operation.

A typical block diagram exemplifying how the MBA-RC might be interconnected with one's amateur setup is shown in **Figure 7-9.** Bear in mind this example illustrates use of many units; some of which would not be required in a particular fixed type of setup. If, for example, the unit was operating "independently," there would only be connections for the keyer, AFSK output to transmitter, speaker input from receiver, and 12 volt 1.2 ampere power source.

Operating the MBA-RC can best be described as "flexability plus." Once the four mode switches are properly set, the unit operates similar to the AEA CP-1 Computer Patch described in a previous chapter: signals are tuned for maximum tuning eye closure and received information is displayed. Overall performance is exceptionally good, and the unit is immune to high levels of RF energy. If you would like a "do anything and go anywhere box". . .a unit that offers capabilities for both present and future gear, you would be wise to consider the possibilities of the AEA MBA-RC.

CHAPTER 8

A GUIDE TO RTTY ACTION ON SHORTWAVES

If you've assumed the majority of interesting RTTY transmissions are conducted exclusively on amateur radio HF bands, you're set for a pleasant surprise. The bulk of printed communications are conducted on various International shortwave frequencies, and they are truly a SWL's haven. Locating these English language transmissions, however, can initially prove discouraging and unsuccessful for uninformed RTTY SWL's. Bearing those thoughts in mind, this chapter will provide both basic information and "cream of the crop" frequency lists which have been specially checked and prepared to ensure your success in RTTY monitoring. Follow the presented guidelines, and get set for some interesting "readings" in the near future!

As we all know, listening to International broadcasts on shortwaves has been a special form of entertainment and education for many years. Every major country in the world operates such shortwave stations; most of which directly beam their signals to North America and Canada during local afternoon and evening hours. The majority of these particular transmissions are conducted on the 49, 41, 31, 25 and 19 meter bands and are listed in the "World Radio TV Handbook," which is published annually. Although possibly a less known fact, many commercial, maritime, military and diplomatic services also send printed transmission via shortwave frequencies. These RTTY signals can easily be received and decoded by using a stable general coverage receiver and an RTTY system such as those discussed in prior chapters. There are ship-to-shore, weather services, general news broadcasts, Associated Press, United Press International, TASS, and much, much more. The keynote to receiving these transmissions simply involves using a good quality setup and an accurate frequency list.

If you're relatively new to the SWL'ing game, we suggest initially spending a brief period tuning specific International Shortwave broadcasts selected from various publications. This will familiarize you with the many parameters of shortwave. . .of propagation effects, varying signals. . .of dependability or electricity of transmissions, etc. Armed with that knowledge, you'll then be ready to receive RTTY transmissions in a knowledgeble manner.

A "better quality" general coverage receiver is highly desirable for receiving RTTY/ASCII/AMTOR/TOR type transmissions on shortwaves. In addition to accurate frequency readout/dial calibration, the unit should be stable and provide various forms of selectivity of IF shifting. Receivers in this category usually range from 300 to 900 dollars in price. Since a large number of shortwave receivers covering 3 to 30 MHz are marketed and since highest costs don't always parallel highest quality, consider asking guidance from a knowledgeble friend or radio amateur and purchase your unit from suppliers with similar interests. Many of the new generation of amateur transceivers feature general coverage receivers, plus the amateur band coverage. The general range is 150 KHz to 30 MHz. Most are very innovative UP conversion digital PLL circuits for superior frequency stability and accuracy. These transceivers make excellent shortwave equipment for all RTTY work.

SOURCES OF RADIOTELETYPE EQUIPMENT

Because of the close nature of amateur radioteletype and radioteletype used by the world press and news services, amateur radio stores have all of the needed equipment for you to receive the news services. These dealers are located in all parts of the country. Most good dealers have this equipment set up and running. Their personnel know RTTY work and can direct you to the best equipment to meet your needs. They also stand behind the equipment they sell.

Many amateur radio and SWL mail order companies know the RTTY systems and actively sell them. Addresses can be found in the shortwave listener's sections of magazines such as Popular Communications, Monitoring Times, Radio and Electronics, World Radio and TV Handbook, and others. Many full-line newstands and electronic shops carry these publications along with amateur radio publications, such as QST, "73," Ham Radio, CQ, and World Radio.

If you desire to write to manufacturers of equipment,

List of Manufacturers with Addresses

☐ Antenna Tuners

Grove Enterprises
Dept. TH
Brasstown, NC 28902

MFJ, Inc.
Dept. TH
Box 494
Mississippi State, MS 39763

☐ Receivers

Kenwood R-2000
Trio Kenwood
Communications, Inc.
Dept. TH
111 West Walnut
Compton, CA 90220

Yaesu FRG-7700
Yaesu Electronics Corp.
Dept. TH
P.O. Box 49
Paramount, CA 90723

JRC-NRD-515
Universal Electronics Inc.
1280 Aida Drive
Reynoldsburg, Ohio 43068
Direct importer for Japan radios
JRC-NRD-515 Receivers

DRAKE R-7A
R.L. Drake Company
Dept. TH
540 Richard Street
Miamisburg, Ohio 45342

☐ Terminal Units

INFO-TECH 200/M-600
Digital Electronic Systems
Dept. TH
1633 Wisteria Court
Englewood, FL 33533

HAL
HAL Communications Corp.
Dept. TH
Box 365
Urbana, IL 61801
Plus other manufacturers
addresses in Section 23

☐ Monitors

Local Amateur Radio Stores
Local Computer Stores

Javlin Electronics Co.
(Manufacturer)
Dept. TH
19831 Magellan Drive
Torrance, CA 90502

AMDEK Corp.
(Manufacturer)
Dept. TH
2420 East Oakton
Arlington Heights, IL 60005

HEATH-ZENITH
Video Display ZVM-121
Heath Company
Benton Harbor, MI 49022

make sure to ask for specific information on the type of equipment you need and where the equipment was featured. Many manufacturers have wide lines of equipment and they must know what you want. Be specific as to your interests and needs, instead of just writing and asking for a general catalog of their equipment. They must know what type of RTTY equipment you require for your system. Some manufacturers have units made expressly for RTTY receive only, others have only transmit and receive units available. Ask them the questions you need answered.

RTTY OPERATORS NOTEBOOK

The second portion of this chapter is specifically dedicated to reception and amateur operation of printed communications. This special treat contains multiple facts, charts and lists which have been carefully prepared and checked to ensure your success in our expanding area which retains its traditional name of simply RTTY. We urge you to keep these listening/operating aids nearby, as having desired information directly on-hand is the key to enjoying any particular aspect of amateur radio or shortwave monitoring. Good luck, and happy 'reading'!

SPECIAL INTEREST TRANSMISSIONS

RTTY WEATHER SERVICE

850 Hz shift 100 wmp normal phase
Sends tropical depressions, storm and hurricane bulletins on the following frequencies.

3235 kHz	10950 kHz
5925 kHz	13624 kHz
8130 kHz	14853 kHz
8140 khz	16440 kHz

MARINE RADIOTELETYPE STATIONS

These coastal stations use telex system called TOR (Telex Over Radio), also same code is called "SITOR," or SPECTOR. These commercial codes are the same as the new amateur AMTOR and can be copied with any equipment that will receive AMTOR.

The traffic is always interesting as it consists of ship traffic, messages, ship movement and personal ship traffic.

Most of these services also carry several press services such as Associated Press and United Press International as part of their regular transmission schedule.

These stations send ID's in CW when not active, or use an idle tone on TOR (AMTOR). Most press schedules appear on the hour and half-hour. Shift is 170 Hz at 100 baud rate.

WCC RCA AT CHATHAM, MAINE

Coastal Frequencies	Ship Frequencies
4356.5 kc	4177.0 kc
6504.5 kc	6266.5 kc
8715.0 kc	8354.0 kc
13081.5 kc	12501.5 kc
17207.5 kc	16670.5 kc
22571.5 kc	22202.5 kc

WLO—MOBILE RADIO, MOBILE, ALABAMA

6501.5 kc
8708.0 kc
13083.5 kc

U.S. COAST GUARD STATIONS

13077.0 kc
17203.0 kc

KPH SAN FRANCISCO, CALIFORNIA

Coastal Station	Ship Station
4356.0 kc	4176.5 kc
6500.5 kc	6262.5 kc
8711.0 kc	8350.0 kc
13077.5 kc	12497.5 kc
17203.5 kc	16666.5 kc
22567.5 kc	22198.5 kc

Other TOR (AMTOR) stations will be found on the following marine bands.

4063 to 4438 kHz
6200 to 6525 kHz
8195 to 8815 kHz
12330 to 13200 kHz
16460 to 17360 kHz
22000 to 22720 kHz

World Press Services Indexed By Country By Service With Frequencies. English Transmissions

AFGHANISTAN					
BAKHTAR Kabul	12085	13410	13570	14720	15865
	15930	16150	17360	17370	
ALBANIA					
ATA Tirana	7850	9133	9430	10435	
PTT Tirana	9388				
ALGERIA					
APS Alger	15480	15482	15486		
ANGOLA					
ANGOP Luanda	11000	22845			
BAHRAIN					
GNA Manama	6954	9197	14764		
BULGARIA					
BTA Sofia	8055	11428	11502	13400	18210
CANADA					
CFH Halifax	8696				
CHINA					
PTT Shanghai	13779	15856	18100		
XINHUA Beijing	6915	7520	7973	9417	11680
	12265	14367	14760	14923	15926
	16136	16412	17214	18872	19850
CUBA					
PL Havana	8140	9362	12280	13405	13907
	14566	14777	14900	14901	16280
	16347	18193			
TASS Havana	14901				
CYPRUS					
DIPLO Nicosia	19443				
CZECH.					
CETEKA Prague	5027	6767	13597	13647	15898
	17525	18985			
PTT Prague	20999				
EGYPT					
MENA Cairo	7756	10151	13652	15845	

ENGLAND					
AP London	6984	6985	9349	10649	12280
	14974	18548	22761		
JIJI London	19396				
LPS London	7446	14645	19395		
REUTER London	6854	6857	9119	10959	10961
	13624	13626	14514	14516	18101
	18102	18334	18337	23543	
FRANCE					
AFP Paris	5842	8022	8023	9394	9396
	10616	10942	13729	14795	14797
	15977	17545	18617	18671	20080
	20082	20312	20313	23752	
DIPLO Paris	16106	16397	18784	20080	20315
	22914				
GERMANY					
ADN Berlin	8068	9966	10543	10786	13895
	14800	14825	16403	18823	19723
	20420	22813	22885		
DPA Hamburg	10128	13482	15996	18697	18698
	18700	18701			
MFA Berlin	15963	19390	19885	23460	
GREECE					
USN Kato	9105	13415			
VOA Kavala	6242	6942	10410		
HONG KONG					
AFP Victoria Is.	7542	10730	19327		
UPI Victoria Is.	9895	19520			
HUNGARY					
MTI Budapest	9114	17468			
INDIA					
INFOIND Delhi	7773	14785	18255	23130	
PTI Delhi	7943	10655	19555		
INDONESIA					
ANTARA Jakarta	19825				
DIPLO Jakarta	16399				
IRAN					
IRNA Teheran	7800	7960	19200	19980	
IRAQ					
INA Baghdad	13524	14699			
ISRAEL					
DIPLO Jerusalem	19743				

ITALY					
ANSA Rome	4804	8105	9052	9082	9383
	9522	10408	12108	12128	13487
	13898	13974	15693	18666	20085
	20245	20430	20728	20752	22955
	24792	25377	27027		
IINA Rome	18675	21805			
SPA Rome	11415	12283	18159	20535	21849
JAPAN					
DPA Tokyo	17597				
JIJI Tokyo	5097	11160			
KYODO Tokyo	5097	12070	12275	14547	14718
	14720	17595			
JORDAN					
PETRA Amman	6675	9463			
KOREA					
KCNA Pyongyang	8020	8153	9395	10580	11230
	12175	13580	13582	13780	14570
	15633				
YONHAP Seoul	7868	11603			
KUWAIT					
DIPLO Kuwait	18990				
KUNA Kuwait	7601	10153	12176	13878	14831
	15887	17379	18262	18308	18309
	20154	20157	20505	20509	20804
	21787	22907			
LIBERIA					
VOA Monrovia	7442	7478	10880	13995	15875
LIBYA					
JANA Tripoli	12186	20560			
MONGOLIA					
MONTSAME Ulan Bator	10335	12250			
MOROCCO					
MAP Rabat	7842	14574	17556	18221	18225
	18496	18696	19171	20786	
VOA Tangier	5460	9855	10972	12223	13770
	14526				
PHILIPPINES					
VOA Manila	19792	20482	26000		
POLAND					
PAP Warsaw	6848	8133	9873	10245	11497
	13543	13635	13785	15508	15996
	17492	18650	20495	21838	
PTT Warsaw	20505				

RUMANIA					
ANGERPRESE Bucharest	6972	9797	21807		
SINGAPORE					
ANSA Singapore	10810	14804	16265	20910	
JIJI Singapore	16150				
KYODO Singapore	20960				
SUDAN					
SUNA Khartoum	18788				
TAIWAN					
CNA Taipei	7695	10960	13563	16223	
TUNISIA					
TAP Tunis	13610	17390	20155		
TURKEY					
AA Ankara	18040				
USA					
AFP New York	15908	23716			
CHATHAM Chatham	6504	6993	8715	13081	13515
	17207	22571			
INFOIND New York	15995	20777	20780		
RCA S. Francisco	13077				
USCG Miami	17203				
USIA New York	14638	18543	22782	23770	
VOA Greenville	15752	19915			
USSR					
AFP Moscow	16185				
APN Moscow	11670	15660	16145	16150	18200
	18245	18440	18540	18635	19127
	20600				
PL Moscow	18600	19505			
TASS Moscow	6870	6950	7760	8140	9110
	9850	10258	10270	10465	10790
	10880	11470	12085	12250	13410
	14470	14510	14700	17510	17570
	18160	18385	18405	18835	18870
	19235	19830	20585	20965	21840
	22782	22791	22890		
VIETNAM					
VNA Hanoi	10600	13463	15744	16383	18256
YUGOSLAVIA					
TANJUG Belgrade	5240	7658	7806	7996	9950
	10438	12048	13440	16065	16343
	17610	19605	20204		

5. Abbreviations of World News Services

ADN
Allegmeiner Deutscher Nachrichtendienst

AFP
Agence France Presse

AFRTS
Armed Forces Radio Television Service

AGERPRESE
Agencia Angola-Press

ANSA
Agenzia Nazionale Stampa Assoziata

AP
Associated Press

APN
Agentstwo Petschato Nowosti

APS
Algerie Presse Service

ASECNA
Agence pur las Securite de la Navigation Aerienne en Afrique et a Madagascar

ATA
Agence Telegraphique Albanaise

BAKHTAR
Afghanistan (TASS)

CETEKA
Ceskoslovensko Tiskova Kancelar

CNA
Central News Agency, Inc.

DPA
Deutsche Presse-Agentur

EMB
Embassy

GNA
Gulf News Agency

IRNA
International Islamic Ness Agency

INA
Iraque News Agency

INFOIND
Indian Information Agency

INTERPOL
Organisation Internationale de la Police Criminelle

JANA
Jamahiriyah News Agency

JIJI
Jiji Tsushin Sha

KCNA
Korean Central News Agency

KDD
Kokusai Denshin Denwa Co. Ltd.

KUNA
Kuwait News Agency

KYODO
Kyodo Press

LPS
London Press Service

MAP
Mutuelle Africain de Presse

MENA
Middle East News Agency

MFA
Ministry of Foreign Affairs

PANA
PARS News Agency

PAP
Polska Agencija Prasowa

PETRA
Jordan News Agency

PL
Prensa Latina

PTI
Press Trust of India

PTT
Postal, Telephone, Telegraph

REUTER
Reuters Ltd.

SANA
Syrian Arab News Agency

SAPORETTI
Argentine News Agency

SNA
Saudi News Agency

SPA
Saudi Press Agency

TANJUG
Telegrafska Agencija
Nova Jugoslavija

TAP
Tunis Afrique Presse

TASS
Telegrafnoje Agentstwo
Sowjetskojo
Sojussa

UN
United Nations Organization

UPI
United Press International

USIA
United States Information Agency

VNA
Vietnamese News Agency

VOA
Voice of America

XINHUA
New China News Agency

ADDITIONAL ABBREVIATIONS

DIPLO
Diplomatic

EE
English Language

FF
French Language

GG
German Language

RR
Russian Language

SS
Spanish Language

NX
Newscast

UN
United Nations

UNID
Unidentified

WX
Weather-Meteo

FEC
Forward Error Correction

TOR
SITOR-Simplex Telex on Radio

ARQ
Automatic Retransmission
Request

AMATEUR RTTY ACTIVITIES

Numerous radio amateurs around the world are joining the action of RTTY on a daily basis, and each relates the same introductory questions. The queries are namely what frequencies and times are popular and how are RTTY/ASCII/TOR signals properly tuned.

Although RTTY transmissions may legally be conducted on any properly licensed CW allocations, they are held to specific ranges by "Gentlemen's Agreements" and mutual respect. Operating within those frequencies thus ensures maximum returns and enjoyment of printed communications. It should also be realized that late breaking and up-to-the-minute changes or modifications to these trends are most likely to first appear in monthly amateur radio magazines.

The American Radio Relay League's official station, W1AW, in Newington, Connecticut transmits official bulletins daily on RTTY. More than a few radio amateurs have "printed their first words" and fine-tuned their systems to the tones of these noted transmissions.

Amateur Radio RTTY Subbands

Amateur Radio RTTY Frequencies in the HF Band

80 Meters	3600-3650 KHz
40 Meters	7075-7100 KHz
20 Meters	14075-14110 KHz
15 Meters	21075-21100 KHz
10 Meters	28075-28100 KHz

Regardless of the band in use, Amateur RTTY is normally transmitted with the space tone being the lower frequency on the air. This requires that the transmitter be set for lower sideband with standard U.S. high tone RTTY equipment.

RTTY is presently not employed on 30 meters

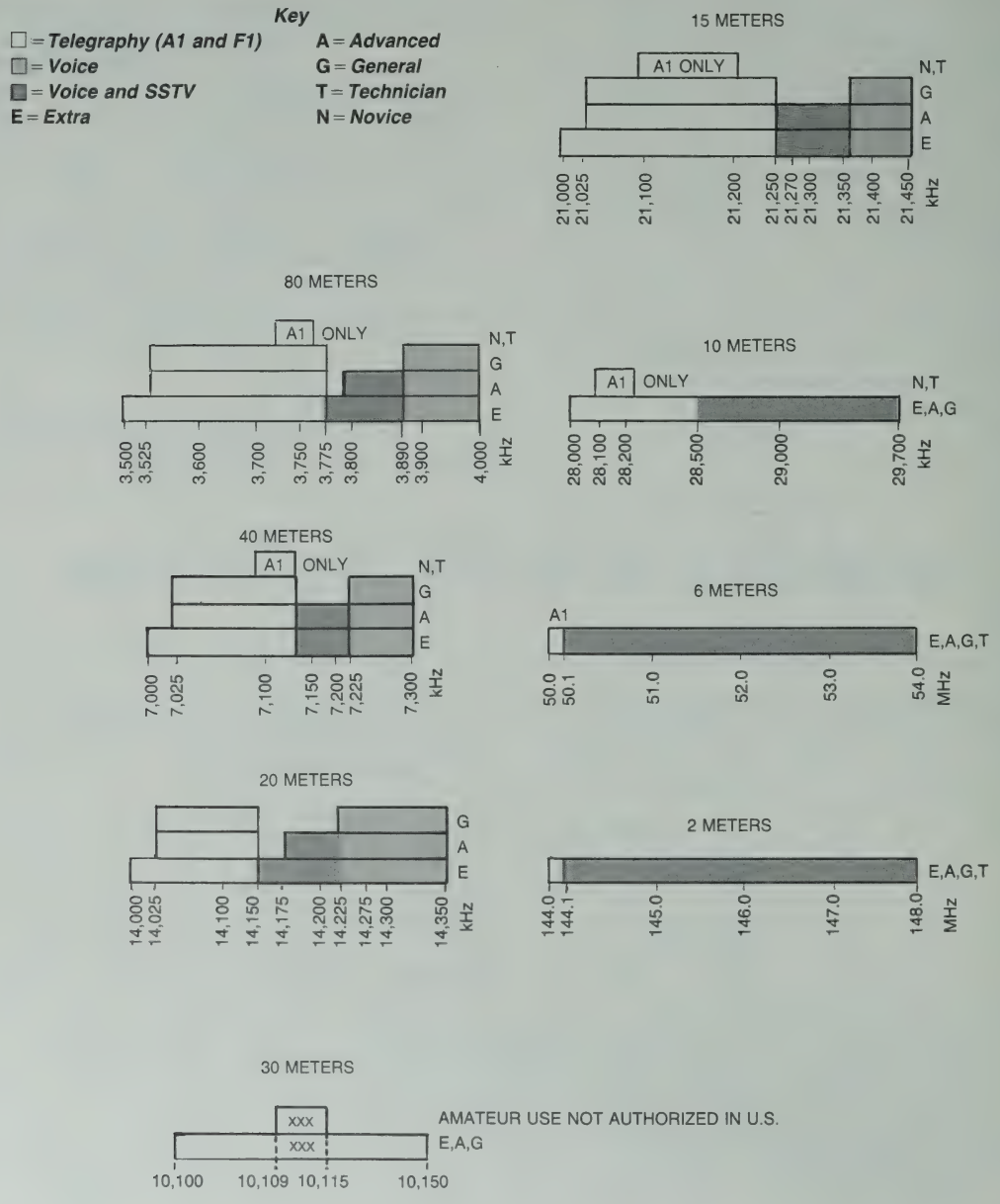
SCHEDULE OF W1AW OPERATIONS

W1AW OPERATING SCHEDULE (APRIL 30, 1978—OCTOBER 29, OF EACH YEAR).

PDST	CDST	EDST	UTC	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
6 A.M.	8 A.M.	9 A.M.	1300*	Slow[1]	Fast[2]	Slow[1]	Fast[2]	Slow[1]		
7	9	10	1400*	——	——	Cw Bulletins[3]	——	——		
8	10	11	1500*	——	——	RTTY Bulletins[4]	——	——		
1 P.M.	3 P.M.	4 P.M.	2000*	Fast[2]	Slow[1]	Fast[2]	Slow[1]	Fast[2]	Slow[1]	Slow[1]
2	4	5	2100	——	——	Cw Bulletins[3]	——	——	——	——
3	5	6	2200	——	——	RTTY Bulletins[4]	——	——	——	——
4	6	7	2300	Slow[1]	Fast[2]	Slow[1]	Fast[2]	Slow[1]	Fast[2]	Fast[2]
5	7	8	0000	——	——	Cw Bulletins[3]	——	——	——	——
6	8	9	0100	——	——	RTTY Bulletins[4]	——	——	——	——
6:30	8:30	9:30	0130	——	——	Phone Bulletins[5]	——	——	——	——
7	9	10	0200	Fast[2]	Slow[1]	Fast[2]	Slow[1]	Fast[2]	Slow[1]	Slow[1]
8	10	11	0300	——	——	Cw Bulletins[3]	——	——	——	——
9	11	12	0400	——	——	RTTY Bulletins[4]	——	——	——	——
9:30 P.M.	11:30 P.M.	12:30 A.M.	0430	——	——	Phone Bulletins[5]	——	——	——	——

[1]Slow code practice on cw bulletin frequencies, 8 minutes each session; *5, 5, 7-1/2, 7-1/2, 10, 13, 15 wpm.*
[2]Fast code practice on cw bulletin frequencies, 8 minutes each session; 35, 30, 25, 20, 15, 13, 10 wpm.
[3]Cw bulletins, 18 wpm, on: 1.835, 3.58, 7.08, 14.08, 21.08, 28.08, 50.08, 147.555 MHz.
[4]RTTY bulletins 60 wpm/170-Hz shift on 3.625, 7.095, 14.095, 21.095, 28.095, 147.555 MHz.
[5]Phone bulletins on 1.835, 3.99, 7.29, 14.29, 21.39, 28.59, 50.19, 147.555 MHz.
[6]W1AW will beam 45° for these transmissions on Mondays, Wednesdays and Fridays during June on 20, 15 and 10 meters. European listeners are encouraged to report use of these transmissions during this trial period.

Amateur Radio HF Allocations



Greenwich Mean Time—Local Time Zones, USA

With this chart you can convert your local time to GMT—GMT is 4 hours ahead (+) of Eastern Daylight Time; 5 hours (+) ahead of Eastern Standard Time and Central Daylight Time; 6 hours ahead (+) of Central Standard Time and Mountain Daylight Time; 7 hours ahead (+) of Mountain Standard Time and Pacific Daylight Time; and 8 hours ahead (+) of Pacific Standard Time.

Greenwich Mean Time	EDT	EST/CDT	CST/MDT	MST/PDT	PST
0000	8 p.m.	7 p.m.	6 p.m.	5 p.m.	4 p.m.
0100	9 p.m.	8 p.m.	7 p.m.	6 p.m.	5 p.m.
0200	10 p.m.	9 p.m.	8 p.m.	7 p.m.	6 p.m.
0300	11 p.m.	10 p.m.	9 p.m.	8 p.m.	7 p.m.
0400	Midnight	11 p.m.	10 p.m.	9 p.m.	8 p.m.
0500	1 a.m.	Midnight	11 p.m.	10 p.m.	9 p.m.
0600	2 a.m.	1 a.m.	Midnight	11 p.m.	10 p.m.
0700	3 a.m.	2 a.m.	1 a.m.	Midnight	11 p.m.
0800	4 a.m.	3 a.m.	2 a.m.	1 a.m.	Midnight
0900	5 a.m.	4 a.m.	3 a.m.	2 a.m.	1 a.m.
1000	6 a.m.	5 a.m.	4 a.m.	3 a.m.	2 a.m.
1100	7 a.m.	6 a.m.	5 a.m.	4 a.m.	3 a.m.
1200	8 a.m.	7 a.m.	6 a.m.	5 a.m.	4 a.m.
1300	9 a.m.	8 a.m.	7 a.m.	6 a.m.	5 a.m.
1400	10 a.m.	9 a.m.	8 a.m.	7 a.m.	6 a.m.
1500	11 a.m.	10 a.m.	9 a.m.	8 a.m.	7 a.m.
1600	Noon	11 a.m.	10 a.m.	9 a.m.	8 a.m.
1700	1 p.m.	Noon	11 a.m.	10 a.m.	9 a.m.
1800	2 p.m.	1 p.m.	Noon	11 a.m.	10 a.m.
1900	3 p.m.	2 p.m.	1 p.m.	Noon	11 a.m.
2000	4 p.m.	3 p.m.	2 p.m.	1 p.m.	Noon
2100	5 p.m.	4 p.m.	3 p.m.	2 p.m.	1 p.m.
2200	6 p.m.	5 p.m.	4 p.m.	3 p.m.	2 p.m.
2300	7 p.m.	6 p.m.	5 p.m.	4 p.m.	3 p.m.

THE BAUDOT DATA CODE

Bit Number 5 4 3 2 1	Letters	U.S. Figures	CCITT#2 Figures
0 0 0 0 0	BLANK	BLANK	BLANK
0 0 0 0 1	E	3	3
0 0 0 1 0	LF	LF	LF
0 0 0 1 1	A	-	-
0 0 1 0 0	SPACE	SPACE	SPACE
0 0 1 0 1	S	BELL	'
0 0 1 1 0	I	8	8
0 0 1 1 1	U	7	7
0 1 0 0 0	CR	CR	CR
0 1 0 0 1	D	$	WRU
0 1 0 1 0	R	4	4
0 1 0 1 1	J	'	BELL
0 1 1 0 0	N	,	,
0 1 1 0 1	F	!	!
0 1 1 1 0	C	:	:
0 1 1 1 1	K	(	(
1 0 0 0 0	T	5	5
1 0 0 0 1	Z	"	+
1 0 0 1 0	L	)	)
1 0 0 1 1	W	2	2
1 0 1 0 0	H	#	£
1 0 1 0 1	Y	6	6
1 0 1 1 0	P	Ø	Ø
1 0 1 1 1	Q	1	1
1 1 0 0 0	O	9	9
1 1 0 0 1	B	?	?
1 1 0 1 0	G	&	&
1 1 0 1 1	FIGS	FIGS	FIGS
1 1 1 0 0	M	.	.
1 1 1 0 1	X	/	/
1 1 1 1 0	V	;	=
1 1 1 1 1	LTRS	LTRS	LTRS

Note: FIGS-H (10100) may also be used for MOTOR STOP function.

"I" = Mark = Hole in punched tape

THE ASCII DATA CODE

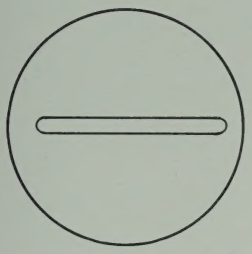
	7	0	0	0	0	1	1	1	1
	6	0	0	1	1	0	0	1	1
	5	0	1	0	1	0	1	0	1
4 3 2 1									
0 0 0 0		NUL	DLE	SPC	Ø	@	P		p
0 0 0 1		SOH	DC1	!	1	A	Q	a	q
0 0 1 0		STX	DC2	"	2	B	R	b	r
0 0 1 1		ETX	DC3	#	3	C	S	c	s
0 1 0 0		EOT	DC4	$	4	D	T	d	t
0 1 0 1		ENQ	NAK	%	5	E	U	e	u
0 1 1 0		ACK	SYN	&	6	F	V	f	v
0 1 1 1		BEL	ETB	'	7	G	W	g	w
1 0 0 0		BS	CAN	(	8	H	X	h	x
1 0 0 1		HT	EM	)	9	I	Y	i	y
1 0 1 0		LF	SUB	*	:	J	Z	j	z
1 0 1 1		VT	ESC	+	;	K	[	k	{
1 1 0 0		FF	FS	,	<	L	\	l	|
1 1 0 1		CR	GS	-	=	M	]	m	}
1 1 1 0		SO	RS	.	>	N	^	n	~
1 1 1 1		SI	US	/	?	O	_	o	DEL

ENQ = acknowledge
BEL = signal bell
BS = backspace (←)
CAN = cancel
CR = carriage return
DC1 = device control 1
DC2 = device control 2
DC3 = device control 3
DC4 = device control 4
DEL = (delete)
DLE = data link escape
ENQ = enquiry (WRU)
EM = end of medium
EOT = end of trans.
ESC = escape
ETB = end of block
ETX = end of text

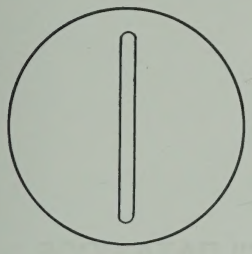
FF = form feed (home)
FS = file separator
GS = group separator
HT = horizontal tab (→)
LF = line feed (↓)
NAK = not acknowledge
NUL = null
RS = record separator
SI = shift in
SO = shift out
SOH = start of heading
SPC = space
STX = start of text
SUB = substitute
SYN = synchronous idle
US = unit separator
VT = vertical tab (↑)

Note: "I" = Mark = Hole in punched tape

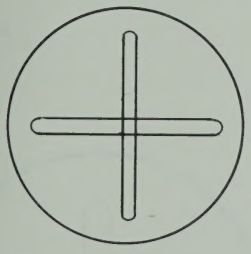
RTTY Oscilloscope Tuning Patterns



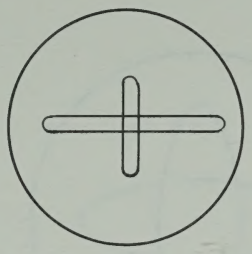
(A) Mark Only



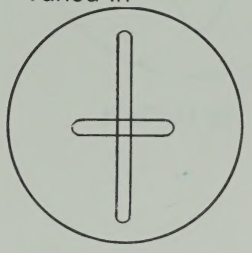
(B) Space Only



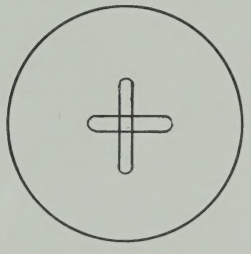
(C) Correct Tuned Mark And Space RTTY Signal



(D) Incorrect, Only Mark Tuned In



(E) Incorrect, Only Space Tuned In

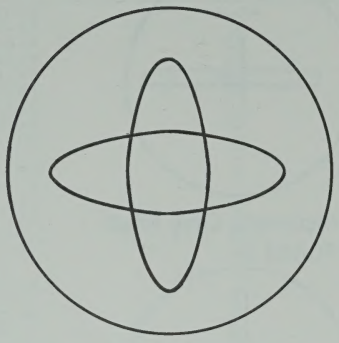


(F) Incorrect, Straddle Tuning of RTTY Signal

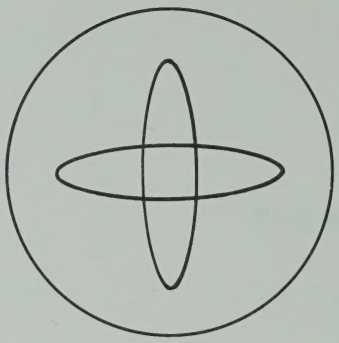
TUNING RTTY SIGNALS WITH AN OSCILLISCOPE

As both radio amateurs and shortwave listeners become involved in the massive world of RTTY, interest in using an oscilliscope for proper tuning increases. Although initial tuning aids and meters may have served well. Time proven 'scope' displays soon prove optimum for such serious RTTY activity. Fortunately, used oscilliscopes are plentiful and inexpensive. Hamfest flea markets and magazine want-ads are good sources to check for these items. Since most RTTY demodulators provide X-Y oscilliscope outputs, interconnection and adjustment is a relatively simple matter. Following connections to the vertical amplifier's input and the horizontal amplifier's input (remember to switch the 'scope' for **external** horizontal sweep), adjust each amplifier for equal deflection. Next, tune some "known" RTTY signals and check for proper display. Reset amplifier ranges and gains as required. A collection of typically-displayed patterns is included for your use and reference.

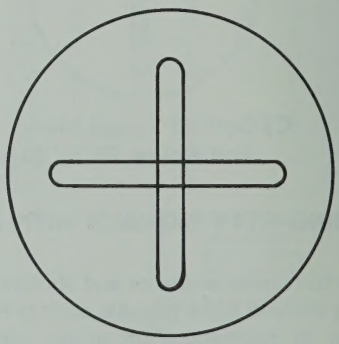
RTTY Oscilloscope Shift Patterns



(A) 170 Hz Shift



(B) 425 Hz Shift

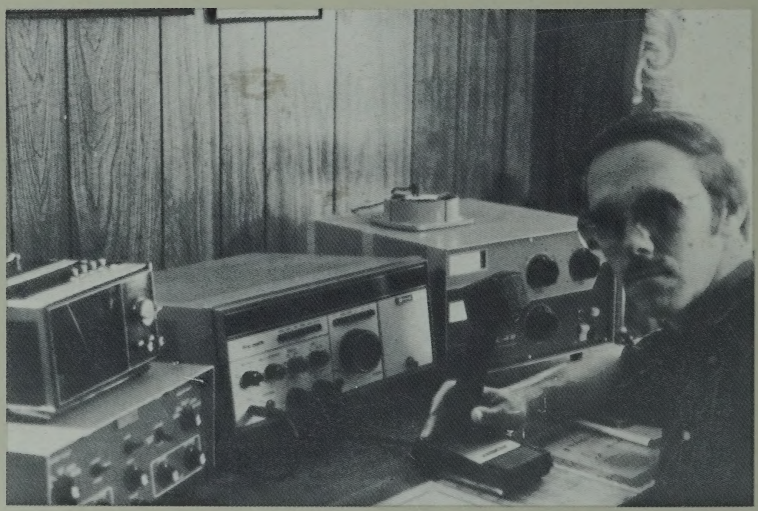


(C) 850 Hz Shift

RTTY TODAY
A Modern Guide to an Exciting New World

The Golden Age of Radio, we're proud to say, is alive and thriving in today's specialized modes of amateur communication.

One of the most popular of these unique areas, radioteletype, has experienced significant advancements during recent times. Home computer systems and dedicated electronic terminals have opened the door for everyone to enjoy the action regardless of their technical background. It's a complete new game of amateur communications and shortwave monitoring, and this all new book is your timely guide to that exciting RTTY world. It's all here and waiting for your investigation...from the fascination of monitoring special news bulletins (see our "pick of the crop" listings in Chapter 8) to the renewed excitement of your first QSO (we've included full details on every type of gear to use). If you would like to truly renew your amateur radio interest and span new horizons, join the thousands of amateurs operating RTTY today. It's Golden and it's great!



Dave Ingram, K4TWJ, is one of the most widely known and respected figures in amateur radio today. (Some folks have said sparks fly off him.) Vividly active on all bands from 160 meters to 70 cm with CW, SSB, RTTY, SSTV, OSCAR, 10FM, etc. he has been licensed for over a quarter century and holds both an amateur Extra Class and a First Phone Radar Endorsed License. In addition to broadcast engineering and teaching both elementary and advanced electronics, he has authored eight published books and over 275 amateur radio articles worldwide. Dave has designed and built a wide variety of equipment, instigated special communications concepts for remote world areas and presented programs on specialized communications throughout the country.